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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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School Surgery.

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V.

ERYSIPELAS—(*continued*).

IT is seen, therefore, that erysipelas may arise in a person prone to it without there being necessarily a seed, or germ, or potent factor, from an antecedent case; some always pre-existing germ having been hatched, so to speak, by abnormal and unusual conditions of the body, and then propagates itself, if circumstances favour it; particles from such a case may then be transferred from it to the tissues of another person. If these particles find damaged material in these tissues, such as are present when a cutaneous injury has been inflicted, and there is the usual reaction which follows injury, viz., an attempt to throw off the damaged tissue, erysipelas may be set up in that tissue, and it then spreads itself from that case to the inmates of the establishment, attacking any one who may happen to be wounded, even if it be only by a scratch. It is very necessary, therefore, when a case of erysipelas arises in a school, that the same rules be adopted for isolation and disinfection as are used against scarlatina or measles, and thus now and then a serious mischief may be altogether prevented. It is not usual for all medical men to look upon erysipelas in the same light that I do, but evidence on this point is too strong to be much longer overlooked. I therefore urge managers to take the safe course, and act in the only way which can prevent the extension of the disease.

Boils.—It is not unusual to find several children in a given school to be suffering from a crop of boils, arising either at the same time or in rapid succession one after another. Boils may be described as hard, prominent swellings, with a deep redness in the surrounding skin, exceedingly painful, and eventually terminating in an imperfect kind of suppuration. They commence in two or three different ways. In one class, a slight itching begins in the skin, which, being scratched, the head of a small papule is taken off and a wound is thus made, from which a minute drop of serum, or blood, exudes; but very soon the base of the papule gets harder, and extends its borders, both on the surface and into the tissue of the cutis vera, or true skin, and spreads to the cellular tissue underneath. Several may appear at the same time. They may arise on the back and about the arms and the neck and legs; indeed, scarcely any part of the body is entirely free from their possible inroads. Another class commences in the cellular tissue beneath the skin, and the first knowledge of the commencement is the discovery of a lump, which is tender when touched. It may be some days before a blush of redness on the skin shows that it is about to break out and discharge. The third kind are deeper still, and form about the fundament and other loose parts, giving rise to abscesses of a considerable size. The figure of the ordinary boil is a small cone, the base of which is below the surface of the skin, and the apex is like the top of a volcano in miniature. This has a whitish speck, under which is a small depression. If the head is removed, a little dead cellular tissue is exposed, with a minute quantity of imperfect pus, or matter, and presently a little serous, or bloody fluid, is discharged. They are generally about the size of a sixpence in superficial area, but the surrounding redness may extend over a much larger surface, and the superficial hardness sometimes exceeds half-a-crown in diameter. They are exceedingly painful when they happen to be in the nape of the neck, or about the joints, as the wrist or armpit, or wherever the skin is liable to friction from the movements of the body or the limbs. In very young children they are often not nearly so painful. I have frequently seen boils of considerable size in teething infants without apparently any suffering attending upon them; but such kinds must be different altogether in character from those which commence in the cutis in the way I have mentioned, and which are capable of propagation from one to another. In some they come singly, and as one gets well another forms, and the crop is kept up for several months; in others a single boil is followed by a regular crop, many appearing together. In some cases they follow attacks of febricula or gastric and other forms of fever. I have seen an establishment in which typhoid fever has attacked several of the inmates, and boils have accompanied the cases, and after the typhoid has been removed some of those who did not suffer from

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typhoid have suffered from a crop of boils, similar to those which appeared on the typhoid cases. They appear in the young as well as in the old, they attack the plethoric or the feeble, and no kind of constitution is certain to be free from their ravages. They are in a manner infectious, and capable of being transferred from one to another. It has happened to myself on several occasions, to have small boils upon my own arms when I have had to treat several other persons, and I have reason to believe that I have caught the disease from my patient; so that in the end I learnt caution, and took care not to get any of the discharges from boils or from their exaggerations, 'carbuncles,' upon any part of my own skin.

Sometimes they are very acute and rapid in their progress, at others they are indolent and slow. These latter have a more hardened base, and are much less painful than the acute variety. There is much difficulty in obtaining any kind of suppuration, and the hardness may remain for several weeks after they have ceased to discharge. Even in the acute form, after discharge has taken place, there is a hardness left behind, and whilst any part of this hardness remains in the cellular tissue, the patient is not free from the chance of a return of his complaint in some other place. The cause of boils is said to be some kind of cacozyme, which develops in the cellular tissue. It is doubtless of parasitic origin. Some excessively minute particles of degenerated protoplasm have been described by several writers, but the exact pathology has not yet been thoroughly worked out. It is very probable that they are connected in their origin with the introduction of some vitiated article of food, such as milk or butter, from a cow which has some defect in its constitution, or from some food which has not been cooked enough to destroy the parasitic germs which may possibly infect it.

Those boils which arise on the surface of the body, and then get deeper in, may be arrested by the action of tincture of iodine. If a drop or two be inserted in the itching papule two or three times in the course of the day, the majority of them will abort, and not develop into typical boils. The point of a stick of lunar caustic is sometimes used, but I prefer the iodine. If it is not successful in preventing the development, it is better not to continue its application for more than a day or two, but to leave the boil to take its course, covering it up with a little resin ointment, or yellow basilicon, as it is commonly called. A small portion of the ointment should be put on the top of the volcano, then a little fluffy cotton wool and a pad of cotton, shaped like a bird's nest; put wool over it, and keep it in its place by a loose bandage, a handkerchief, or a slip or two of adhesive plaster, so that all pressure may be taken off the sore, and friction altogether prevented. This kind of treatment is much more satisfactory than that which is so often used, viz., by poulticing the boil. It will always be noticed that a boil which has been poulticed for any time is certain to be followed by a crop of secondary boils around the first. It is also certain that the warmth and moisture which a poultice promotes places the surrounding skin in the most favourable position for the growth of the parasite, upon which I believe that the extension of the boil depends. I have given up the use of poultices for a long time past. Still, when the boil is close to one of the orifices of the body, and liable to be rubbed, it may be useful and very comforting to poultice for a few hours just before the time of discharge, if there is retained matter; but as soon as it commences to discharge, the poultice should be at once discontinued and the yellow basilicon applied. The ointment should be continued as long as there is the least appearance of discharge from the place. Some persons put a a piece of plaster over the boil and leave it alone altogether. It is a successful practice sometimes, after treating a boil with tincture of iodine for a day or two; and if the place shows signs of departure, it may 'speed the going guest,' and save it from friction and irritation; but to put a plaster on a boil which is really developing is an uncomfortable proceeding, and not nearly so satisfactory in its results as keeping the top of the boil moistened with yellow basilicon. If the place is small, a portion of chamois-leather soap plaster may cover it, first putting on a small piece of wool having ointment upon it covering the boil. In that case the plaster should be cut crossways just over the boil, so as to prevent any pressure upon the top of the boil itself. When they form in the neighbourhood of the fundament, the victim should keep in bed, and occasionally foment the part with a sponge wrung out of hot water. Boils in that position may be dangerous, and lead to other troubles.

It used to be the custom to lance boils. I have had them cut across with a crucial incision, and treated others in the same way. It is a barbarous custom, and does not help the case forward a bit, except in those which are indolent and will not suppurate, and are in awkward situations, as in the armpit or between the thighs. In any case, I think it bad practice to cut them crucially. It never does to produce a greater injury to cure a lesser one, and a great injury may be done by cutting into flesh which should not be interfered with. The surgeon may sometimes see the necessity for incision from the possibility of other mischief, such as may arise from pressure upon an important organ, or because there may be a tendency to extend in the deep tissues, especially those in the neighbourhood of the anus or armpit; but, except in such situations, it is far better to leave nature to perfect her own work, and to let the tissue in which the parasite has spread its venom be thrown off out of the body by natural means. Neither do I think it of any use to give medicine to those who suffer from boils, unless some function is improperly performed, or some evident defect of power is present. If there is foul tongue, loss of appetite, confined bowels, and other constitutional disorders, each symptom should be treated according to the rule which will be laid down hereafter for each departure from natural states. It is really useless to give the medicines which are sometimes highly recommended, such as yeast, porter, and wine. Such things don't really help the case. The general condition of the patient should be dealt with according as to whether 'he is well nourished or enfeebled and anæmic.' Quinine and iron, in some form or other, will be beneficial if the face is pale and the patient weak, and mineral acids may be useful, but they should be only prescribed under medical direction, and stimulants as a rule are worse than useless.

Carbuncle.—It is not unusual for a so-called carbuncle to develop out of an ordinary boil. The hardness at the base of the boil does not resolve itself in the usual manner, but vitality ceases in a large part of it, and it is thrown off as a slough, several holes ap-

pearing upon the surface. There is gangrene in the skin and the cellular tissue underneath, in consequence of a complete blockade of the circulation, through a number of the capillaries or minute vessels which supply the skin. This block is effected by a more extended development of the same or a parasite similar to that which gives rise to a crop of boils. The carbuncle may appear as a small speck at first, but it sometimes rapidly develops itself, especially in the nape of the neck, and often sets up serious mischief. If the place is only an inch or so in diameter, it may be treated precisely in a manner similar to that prescribed for boils, viz., with yellow basilicon and cotton wool. If there is much slough, it is a good plan to sprinkle upon it at each dressing a few grains of animal charcoal. This application destroys the foul odour which sometimes arises, and clears the wound imperceptibly of the slough and its disagreeables. It must be done carefully, otherwise it creates a black-looking patch, and tends to frighten the patient into a belief that there is general mortification. Carbuncles, as well as boils, easily bleed if they are rubbed, or if the slough is dragged away by violence. The core or slough should be allowed to separate without using any force, and if the hole which forms in consequence of the destruction of skin is filled with soft cotton, first applying on the place a little softened basilicon, it will be the best kind of treatment that can be used. When the place is excessively painful, it may be fomented occasionally with some hot water in which a few poppy heads have been boiled. Some prefer a poultice made with boiled carrots. It is useful when there is much slough, and may be applied for two or three hours a day with advantage, especially in those cases in which charcoal powder has been used. It is very important to keep a case of this kind very clean, and to burn up all the dressings which have been used or any rags which have been soiled.

(To be continued.)

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Anecdotal Natural History.

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No. XVII.—THE MONKEY TRIBE.
PART V.

THE Cacajao (*Pithecia melanocephala*), another of the Brazilian monkeys, may be easily distinguished from all the other American *quadrumana* by the black head, to which the specific title refers, and, more particularly, by the extreme shortness of the tail. This organ is of wonderfully small dimensions, occupying little more than five inches in a cacajao of adult size, measuring, perhaps, two feet six inches in total length.

For some years after this animal was discovered, the abbreviated tail was thought to be due to the attacks of other monkeys, who are much in the habit of nibbling the caudal appendages of their comrades whenever a convenient opportunity for so doing presents itself. Upon looking at a cage where a number of monkeys are confined together, we are sure to notice that the tails of the smaller and more weakly inmates are reduced often to half their proper dimensions, owing to the persevering attacks of their larger and more powerful brethren.

It has since been proved, however, that with regard to the cacajao, nature alone is responsible for the seemingly imperfect character of the tail, which appears never to occupy more than one-sixth of the entire length of the animal.

The head of the cacajao is of a rather peculiar form, the temples being flattened, instead of rounded, as is the case with monkeys in general.

With the exception of the head and the fore-paws, which are of a deep black, the fur of the cacajao is a bright yellowish-brown. The ears are devoid of hair, and are very large in proportion to the size of the head.

This is by no means one of the most plentiful of the monkey tribe, and, owing in part to its scarcity, and also to its quiet and retiring disposition, we know very little of its habits when in a state of freedom. It appears to be chiefly or entirely a vegetable feeder, fruits of various kinds seeming to form the major part of its diet.

THE pretty little Douroucouli (*Nyctipithecus trivirgatus*) is very seldom seen at large, its habits being almost entirely nocturnal. Indeed, its eyes are so sensitive as to be unable to endure the light of day, and not until darkness has fairly set in does the animal leave its place of repose in order to prosecute its search for food.

This food consists chiefly of small birds and insects of various kinds, in the capture of which it displays considerable address. It is even able to catch the night-flying insects when upon the wing, striking them down with a blow of its ready paw as they flit past its perch.

The douroucouli is remarkable for the small size of the ears, which indeed are quite invisible unless the fur be pushed aside. Owing to this peculiarity, the animal was formerly placed by itself in a distinct family, under the title of *Aotes, i.e.*, 'earless.'

The douroucouli is by no means uncommon in various parts of Brazil, but owing to its nocturnal habits is only very occasionally seen. It is not gregarious, like the generality of the monkey tribe, but appears to pass an almost solitary existence, contented with the society of the members of its own family.

There are several species of douroucouli, three of which, namely, the Three-banded Douroucouli, the Feline Douroucouli, and the Red-footed Douroucouli, have been kept in the Zoological Gardens within the last few years. No less than nineteen specimens of the Feline Douroucouli have been placed in the Gardens since 1857.

ONE of the prettiest and most graceful of all the monkey tribe is the common Marmoset (*Hapale jacchus*), a native of Guiana and Brazil. It is quite a small animal, its length being seldom more than seven or eight inches, exclusive of the tail, which measures about a foot.

The ground colour of the fur, which is singularly long and fine, is partly white and partly reddish-yellow, boldly variegated with streaks of blackish-brown. The tail is white, banded at short intervals with rings of a deep blackish hue. From either side of the head springs a tuft of radiating white hairs which impart a very singular appearance to the countenance.

Owing to its wonderfully gentle and docile nature, the marmoset is in great favour as a pet, and very shortly becomes perfectly domesticated, making itself fully as much at home in its new abode as does a favourite dog or cat.

The diet of the marmoset is of a very varied nature, and embraces both animal and vegetable substances. When in a wild state it appears to subsist chiefly upon insects, eggs, and fruits of various kinds, while it does not seem averse to a small bird when it is fortunate enough to capture one.

When domesticated, it generally turns its attention to the cockroaches, should the house be infested with these insects, eating the smaller ones entire, but carefully stripping off the heads, wings, and legs of the larger specimens before proceeding to devour them.

I once made friends with a beautiful little marmoset through the medium of flies. It was shy and retreated from me when I approached it. Presently, I saw it steal cautiously towards a fly that had settled near it and try to catch the insect.

So, I caught a fly, and held it up by the wings in front of the marmoset. The buzzing of the fly attracted it at once, and it came very slowly towards me. It then put out its paw timidly once or twice, making a little whimpering or twittering cry the while, and at last summoned up courage enough to take the fly.

It made but little difficulty in coming for a second fly, and soon was on the best of terms with me.

Within the last six years some twenty specimens of this marmoset have inhabited the Zoological Gardens.

A monkey very closely allied to the preceding animal is the Marikina (*Midas rosalia*), or Silky Marmoset, which is, perhaps, even more pretty and graceful an animal than even the marmoset. The fur, which is wonderfully soft and silky, is of a bright chestnut hue with a peculiar golden lustre, darkening slightly upon the paws and upon the upper portions of the limbs, but preserving a uniform tint upon the remaining parts of the body. The animal is termed the Silky Monkey on account of the silken texture of the long and glossy fur. Sometimes, also, it is known as the Lion Monkey, from the mass of long hair upon the head, which is thought to bear a resemblance to the mane of the lion.

The marikina seems to be fully aware of the beauty of its silky coat, and takes the greatest care to keep it free from the slightest speck of dirt. When kept in confinement, its surroundings must be kept scrupulously clean in order to preserve the health of the animal, which is sure to die before long if this precaution be not attended to.

In point of size, the marikina is as nearly as possible equal to the marmoset, the tail, also, bearing about the same proportion to the body as in that animal.

There is another darling little monkey that belongs to this group. It is popularly called the Pinche (a French word), and is scientifically named *Midas Œdipus*.

There is no difficulty in distinguishing this little creature on account of the long, white hairs that cover the head, and look very much like the full dress wig of our judges. The throat, chest, and abdomen are also white, and the rest of the body is greyish-black, except a patch of reddish fur on the shoulders.

Before taking leave of these monkeys, I must call attention to a statement of the late F. Buckland. He had much experience in monkeys and their ways, and was convinced that the monkeys of the New World were much superior in intellect and temper to their kinsfolk of the Old World. He strongly advises every one who wishes to keep a monkey to select one of the South American species, and to reject any that come either from Asia or Africa.

WE must now bid farewell to the monkeys of the American continent, and proceed to the curious group of *quadrumana* known, both popularly and scientifically, as LEMURS, all of which are natives of Madagascar and the neighbouring islands.

Few people, at first sight, would consider these animals to belong to the monkey tribe, their appearance and movements being far more quadrupedal than is the case with any of the *quadrumana* about which we have hitherto been reading. The aspect of the head, too, differs very considerably from the usual monkey type, the jaws and muzzle being narrowed and elongated in a manner which irresistibly reminds the observer of the common fox of our own country.

However, notwithstanding the points in which the lemurs differ from the remaining animals of the group, the structure of the paws at once points out their position in the animal world. Both the fore and hind paws are furnished with thumbs, which are opposable to the fingers, and can be employed with considerable dexterity in the manipulation of small objects.

All the monkeys of this group are remarkable for their stealthy and noiseless movements, and this peculiarity, together with their nocturnal habits, has earned for them the title of lemurs, which word signifies a night-wandering ghost.

The largest, and one of the most handsome of the group, is the Ruffed Lemur (*Lemur macaco*), an animal in which the contrast of colour is remarkably striking. The face, the fore parts of the body, the feet, the tail, and a patch upon the back, are of a jetty-black hue, while the remainder of the fur is of the purest white. A ruff-like fringe of long, white hairs surrounds the face, and has earned for the animal its popular title.

Although not a very uncommon animal, the ruffed lemur is far more often heard than seen, its hoarse, barking cry being audible for a considerable distance. It is fond of assembling in large flocks, the members of which lift up their voices in concert, producing sounds almost deafening in their intensity.

The character of this animal is very timid and retiring, and when attacked or pursued, it seems invariably to seek safety in flight whenever such a course is practicable. Should it be driven to bay, however, it will fight with great ferocity, using its sharp teeth with considerable effect.

A still prettier animal is the Ring-tailed Lemur, or Macaco (*Lemur catta*), which may be instantly recognised by the long and banded tail. It is not so large as the preceding animal, the head and body seldom exceeding a foot in total length, while the tail measures some seven or eight inches.

The fore arm and hand of this lemur are remarkable for a peculiar structure which causes the fingers to close mechanically when the limb is extended. The animal is thus enabled to suspend itself from a branch for a considerable time without fatiguing the muscles in any great degree.

The Diadem Lemur (*Propithecus diadema*) derives its name from the semi-lunar white stripe upon the forehead. Owing to one or two minor points of structure, this animal has been placed in a different genus from the preceding members of the group.

It is not a very brightly coloured animal, but may be easily distinguished from all it congeners by the white crescent-shaped mark upon the black face. The fore parts of the body are of a sooty black colour, which gradually fades into a pale brown upon the hinder quarters and the limbs. Beneath, the body is almost white.

Owing to their shy, nervous, retiring ways, the lemurs have been very happily called "the monkeys' poor relations."

Many examples of several species of lemurs have been kept in the Zoological Gardens. Generally they are asleep during the day, but they may be sometimes roused to action by the offer of a lively beetle or other insect. As they take it, the peculiar structure of the fingers may be noticed, each finger having a flat, soft pad at the tips, extending far beyond the nail. The lemurs are inquisitive creatures, and if a finger be put into their cage, they will take hold of it and examine as curiously as a money-changer scrutinizes a doubtful coin.

At dusk, however, the lemurs begin to wake up to their real day, and they traverse their cages with an activity that affords a curious contrast with their sluggish movements when the sun is above the horizon.

THE animals bearing the title of LORIS may be easily distinguished from the lemurs, which they otherwise closely resemble, by the entire absence of tail, the lack of which imparts to them a very singular appearance. The form of the head, too, is different, for, although the muzzle is as sharply pointed as in the lemurs, it becomes so very abruptly, and does not taper gradually from the ears to the nostrils, as is the case with the preceding animals.

The manner in which the blood-vessels of the limbs are modified in these animals is worthy of notice. The arteries, as they enter, and the veins, as they leave each limb, suddenly separate into a number of cylindrical vessels, which send off their branches in different directions. It is thought that this peculiar structure may be connected in some manner with the stealthy and silent movements which are so great a characteristic of the animals.

The Slender Loris (*Loris gracilis*) is a native of Ceylon, Java, Sumatra, and the neighbouring islands, where, however, owing to its small size and nocturnal habits, it is comparatively seldom seen.

Silent and stealthy as are the lemurs, the loris is so in an even greater degree. Sallying forth from its retreat after darkness has fairly set in, it is accustomed to prey upon various small birds as they roost among the branches, approaching them with a caution and address which never fail in securing the desired object. Moving by almost imperceptible degrees, the loris creeps up to its prey, and not until its fingers actually surround the unconscious victim is any intimation given of its approach.

This loris is quite a small creature, measuring only nine inches in length when fully adult. The limbs are very slender, and, indeed, the whole form is so slight and delicate as to have earned for the animal the specific name of '*gracilis*'—*i.e.*, graceful. The colour of the fur is grey, deepening slightly upon the face, and paling almost to white upon the lower parts of the body.

The Kukang, or Slow-paced Loris (*Nycticebus javanicus*), although similar in habits to the foregoing species, is yet very different from it in size and appearance. It is a decidedly larger animal, being upwards of a foot in total length. The colour of the fur is darker, and a deep chestnut-brown stripe surrounds the eyes and ears, running from thence along the entire length of the spine.

The kukang appears, when in a wild state, to subsist almost entirely upon small birds and insects of various kinds. In captivity, however, it becomes far less particular, and will feed both upon animal and vegetable substances, always, however, giving the preference to the former.

One of the smallest animals of the monkey tribe is the Little Galago (*Galago minor*) of Madagascar, which does not exceed in size an ordinary rat. Neither is its resemblance to that animal confined to size alone, for its whole appearance is so strongly suggestive of the little rodent with which most of us are only too well acquainted that it is often known as the Madagascar rat.

Like most of the animals of the group, it is nocturnal in its habits, seldom issuing forth from its concealment until the shades of night have fairly set in.

The little animal known as the Tarsier (*Tarsius spectrum*) is chiefly remarkable for the extraordinary length of the paws, which are longer in proportion to the size of the body than in any other member of the monkey tribe. This peculiarity is caused by the elongation of the tarsal bones of the hands and feet, whence the popular name of 'Tarsier' is derived. The animal is a native of various islands of the Malay Archipelago.

The tarsier is wonderfully active amongst the branches of its forest home, hopping from bough to bough in a manner which reminds the observer of the motions of a frog.

WE now come to an animal which has proved a terrible puzzle to zoologists, who were long uncertain as to its true position in the animal world. This is the Aye-aye (*Cheiromys Madagascariensis*), in which the characteristics of the *quadrumana* are strangely mingled with those of the *rodentia*. In the general form of the body, and in the structure of the paws, the aye-aye closely resembles the Galagos and the monkeys allied to them, while the formation of the teeth is almost exactly similar to that found in the rodent animals. Indeed, the only important difference seems to be that, whereas the incisor teeth of the rodents are furnished with a broad chisel-like edge, those of the aye-aye are sharply pointed.

In still another manner does the aye-aye differ from all the other members of the monkey tribe, for the mammæ of the female are placed upon the lower part of the abdomen, and not, as is generally the case, upon the breast.

On account of these teeth, Buffon placed it among the rodents. Cuvier, however, decided that it could not be a rodent on account of its paws, which resembled those of the monkey tribe, and accordingly placed it among the doubtful animals.

As to the front paws, there is a peculiarity in them, which is not to be found in any other animal. The third finger is much longer and more powerful than any of the others (the thumb being considered as the first), while the middle finger is so attenuated that it scarcely seems to belong to the same animal.

In 1859, Dr. Sandwith was fortunate enough to procure a living specimen, a male, in good health. The creature immediately began to gnaw its cage, and so Dr. Sandwith supplied it with tree branches. It so happened that some of these branches were tenanted by wood-boring grubs, and then the object of the peculiar teeth and finger was apparent.

The animal tapped the branches with the middle finger, and listened in order to detect the presence of a grub. It then rapidly gnawed away the wood, poked the long and slender finger into the hole, and hooked out the grub with its claw-like nail.

The aye-aye uses this slender finger in dressing its fur, keeping the other fingers closed.

Contrary to the usual rule, the fourth finger is the longest, and is employed by the aye-aye in drinking, the animal whipping the liquid into its mouth by quickly repeated strokes of the finger, just as a Chinaman can eat soup with his chopsticks.

The large bushy tail is useful to the aye-aye, and is used by way of bed-clothes, the animal curling itself up, and covering itself with the tail.

A fine female specimen was placed in the Zoological Gardens in 1862, and as she lived for some time, the habits of the creature could easily be studied. I saw her often, and wrote a tolerably full description of her in the *Boy's Own Magazine*, accompanied by an admirable portrait by the late Mr. T. W. Wood.

It is not often that a foreigner discovers an animal of which the natives are totally ignorant. But, when Sonnerat found the first specimen known to science, the natives were quite astonished, and cried out, 'Aye! Aye! Aye!' in token of surprise. Hence its popular name.

The aye-aye is a native of Madagascar, where, together with the lemurs and one or two allied animals, it seems to take the place of the usual quadrumanous forms. It is an exceedingly rare animal, and appears to be confined to the western portion of the island. Owing to its great scarcity and nocturnal habits, we know very little of its mode of life in a wild state, and have, indeed, much to learn with regard to all the members of the group to which it belongs.

THE extraordinary animal known as the Colugo, or Flying Lemur (*Galeopithecus volans*), evidently forms a connecting link between the monkeys and the bats, uniting in its own person the characteristics of the two groups.

The limbs and tail are connected with each other by means of a wide membrane, which, when extended, transforms the animal into a kind of living kite, enabling it to sweep through the air for very considerable distances merely by the impulse of the primary spring. According to Mr. A. W. Wallace, it seems to have some little power of directing its flight, for in his well-known work on the 'Malay Archipelago' he tells us—'Once, in a bright twilight, I saw one of these animals run up a trunk in a rather open place, and then glide obliquely through the air to another tree, on which it alighted near its base, and immediately began to ascend. I paced the distance from the one tree to the other, and found it to be seventy yards; and the amount of descent I estimated at not more than thirty-five or forty feet, or less than one in five. This I think proves that the animal must have some power of guiding itself through the air, otherwise in so long a distance it would have little chance of alighting exactly upon the trunk.'

While not in use, the membrane which connects the limbs and tail is wrapped so closely to the body as to be almost invisible, in order that the movements of the animal may in no way be incommoded. The upper surface is thickly clothed with hair, like the remainder of the body; the lower, however, is almost naked.

The mammæ of the female are four in number, instead of two, and are placed upon the lower part of the abdomen, just as is the case with the aye-aye.

The paws show very decided modifications from those of the preceding animals, for the thumbs are not opposable to the fingers, and the place of the nails is taken by sharp, hooked, and retractable claws.

The colugo is nocturnal in its habits, passing the hours of daylight suspended to some branch by means of its hinder limbs, much after the fashion of the bats which it so much resembles. It seems to feed upon both animal and vegetable substances, eggs, small birds, insects, and fruits of various kinds forming the major part of its diet.

The colugo is by no means a small animal, a full-grown specimen being about equal in size to a large cat. It is found in many of the islands of the Indian Archipelago.

(To be continued.)

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Eminent Practical Teachers.

PESTALOZZI.

BY THE REV. CANON WARBURTON, M.A.,
Her Majesty's Inspector of Training Colleges for Schoolmistresses.

V.

THE teaching of Pestalozzi may be considered a new point of departure in the history of education, but from the very fact that modern elementary education has been so completely Pestalozzianized we are apt to forget how much it owes to Pestalozzi. His principles have, in the main, met with such universal acceptance, that they seem to be almost self evident, and to have come to us, as it were, by the light of nature. We are inclined to ask, Who that had turned his attention to the subject, could fail to see that education to be successful must begin with the first dawn of intelligence, must follow the natural order of the development of the faculties, must start from the point at which the child is standing, and advance outward in concentric circles, to embrace wider and wider fields of knowledge? Yet it cost Pestalozzi the unremunerated labour of fifty anxious years, and the sacrifice of all that makes life dear, to bring home these and a few more equally elementary truths to the intelligence of mankind.

Are we then to suppose that no one ever thought of these 'principles' before Pestalozzi first promulgated and exemplified them? The wise man has told us that 'there is nothing new under the sun,' and it is true that most of the constituent parts of his

system are to be found scattered up and down like broken lights in the earlier history of education, and his work consisted mainly in concentrating them into one focus. Thus Pestalozzi's fundamental principle, that the mother is the first and best of educators, and the home the first and best of schools, had been a leading feature in Roman education 2,000 years before. Luther, in the sixteenth century, and Comenius, the famous Moravian bishop, in the seventeenth, had taught that education should begin 'with the mother's school in every home.' Comenius again had anticipated Pestalozzi in enunciating the truth that education should follow the order and course of nature, and be so contrived as to take advantage of the fact that man has an innate tendency to improve the faculties with which he has been endowed. Again, the famous Jesuit teachers of the Renaissance anticipated Pestalozzi in seeing that a primary condition of success in education is to gain the confidence and attachment of the scholar, so as to be able, from thoroughly understanding his nature and character, to apply the guidance, incentive, or restraint, best suited to the wants of each. From the example of the Jansenists of the too short-lived Port Royal Schools, Pestalozzi might have borrowed another leading feature of his system, namely, to discard emulation, as an incentive to studious exertion, and to endeavour to supply its place by making the pupil find delight in the sense of his own accumulating knowledge and his own progress and growth in intellectual power. I use the expression 'might have borrowed' advisedly, for Pestalozzi apparently knew little, and cared less, for the previous history of educational experiments. It was one of the most unfortunate and fatal weaknesses of his position that he had early learned from his master, Rousseau, to 'hate and despise books,' and to recognise no merit or value in the exertions and the experiences of the great teachers who had preceded him. In what then does the importance and originality of his work consist? Chiefly in this, that having made out for himself a few leading principles which he believed to be true (and which turned out to *be* true in the main), he set himself to the task of promulgating them with such dogged perseverance, such intensity of conviction, and such entire self-devotedness, that he compelled the world to listen to him at last. It was to this, 'the divine faculty of taking pains,' which, according to the Germans, is the true definition of genius, that Pestalozzi owed his success as a practical teacher; for it must be confessed that there was hardly one of his own principles of education which he strictly adhered to in the actual conduct of his schools. In fact, he pathetically laments on more than one occasion the discrepancy between the beauty and truth of his principles and the imperfections of his practice. He was a poor unlearned man who had undertaken to grapple with some of the profoundest problems which have exercised the ingenuity of mankind, and though his insight was clear, he constantly felt the inadequateness of his practical powers to carry out his magnificent ideals. By way of illustrating the inconsistencies which appear in Pestalozzi's system, when fact comes into collision with theory, may be mentioned that while he justly regards the mother's instincts as the best guide to the treatment of the infant mind when it first begins to observe and inquire, he finds himself encountered by the difficulty that not one mother in ten is capable of the task of developing the perceptions of her child. He is compelled, therefore, to fall back upon Compendiums of Knowledge to be put into the mother's hands—compendiums, which he asserts will 'enable the mother of the most limited capacity to instruct just as well as the most talented. The mothers have only to keep strictly to these books in the instruction of their children.' These compendiums 'brought down some not unnatural, and perhaps not altogether undeserved, ridicule upon their author's head. As an example of the method of teaching 'Language'—'the mother's spelling book,' says he, 'must contain the entire range of sounds of which the language consists, and portions of it should be repeated daily in every family, not only by the child who is going through the exercises in order to learn how to spell, but also by mothers, within hearing of the child in the cradle, in order that these sounds may by frequent repetition be so deeply impressed upon the memory of the child, even while it is yet unable to pronounce a single one of them, that they may never be forgotten. No one imagines to what a degree the attention of infants is aroused by the repetition of such simple sounds as ba, ba, ba, da, da, da, ma, ma, ma, la, la, la, or what a charm such repetition has for them.' On this passage, one of Pestalozzi's biographers remarks, 'if the rocking songs sung to the babe in the cradle are to consist of such bleating as this, it is enough to frighten away its guardian angels.'

Again he constantly enlarges, and justly, on the mischief arising from mere word-knowledge in education, as opposed to that derived from perception and experience. 'In our lower school establishments,' he says, 'the mind is loaded with a burden of empty words which has not only effaced the impressions of nature, but has even destroyed the inward susceptibility to such impressions.'

But in the book for mothers, and indeed elsewhere, occur passages which seem to show that Pestalozzi attributed something little short of a magical power to words. The lessons are found to consist not even in the naming of objects, so much as in the acquisition of names, for their own sake. 'Lessons in nature consist in giving the children lists of the names of the most important objects in all three kingdoms of nature, etc. The lists of words are placed in the hands of the child merely as exercises in learning to read, and I have found that it is possible to make the children so thoroughly acquainted with these lists of words that they shall be able to repeat them from memory in the time that is required to perfect them in reading.' As an example of a less objectionable but still quaint and roundabout method of teaching language through observation, the following passage is quoted from the experiences of Ramsauer, who has already been mentioned as a pupil of Pestalozzi. 'The hangings (in the castle of Burgdorf) were very old and torn, and before these we had frequently to stand for two or three hours together, and say what we noticed in respect of the form, number, position, and colour of the figures painted on them, and the holes torn in them, and to express what we observed, in sentences gradually increasing in length. On such occasions he would say, "Boys, what do you see?" (He never named the girls.) *Answer:* "A hole in the wainscot." *Pestalozzi:* "Now repeat after me:—I see a hole in the wainscot—I see a long hole in the wainscot—through the hole I see the wall—through the long narrow hole

I see the wall. I see figures on the paper-hangings—I see black figures on the paper-hangings—I see round black figures on the paper-hangings—I see a square yellow figure on the paper-hangings—and so on."' And this curious illustration of his practical subordination of observation and association to names and mechanical detail, is to be found in his method of teaching geography. He proceeds thus:—'One of the sub-divisions of Europe is Germany. The child is first of all made acquainted with the divisions of Germany into ten circles, then the names of the towns of Germany are placed before him, at first in mere alphabetical order for him to read, but each of these towns is previously marked with the number of the circle in which it lies. As soon as the child can read the names of the towns fluently he is taught the connection of the numbers with the sub-division of the main-heads, etc., etc.' In all this, be it observed, there is no hint of the use of a map.* But not to weary the reader with further details, it may be said that Pestalozzi has, as it were, set his own seal and signature to the indictment which experience has brought against his methods, in recording the following incident. M. Glayre, a member of the Executive Council of Bern, in hearing an explanation of his system, made the ominous remark, 'You want to make education mechanical.' 'He hit the nail on the head,' says Pestalozzi, and supplied me with the very expression that indicated the object of my endeavours, and the means which I employed for attaining it.' It must be borne in mind that Pestalozzi was a self-taught man, and all the blunders which occasionally deface his system were those of a self-taught man. It has been well said of him that 'he wanted the historical basis.' Methods which had been discovered long before, tried and found wanting, appeared to him as new revelations made to himself, and he had to learn their inefficiency by bitter personal experience—and at his pupils' cost. Everything had to be 'evolved,' like the well-known German camel, 'out of his own consciousness,' and he exhausted himself in inventing expedients which either were worthless when brought to a practical test, or had been invented and brought to perfection long before, if he had only known of them.

These inconsistencies have been dwelt on thus far, and at some length, partly because they seemed necessary elements in a true portraiture of Pestalozzi, and partly to account for the fact that many of his methods have been consigned to a not wholly unmerited oblivion, while his principles have exerted an ever-growing influence on popular education, stronger, perhaps, at the present time than when he was their living exponent, and at the zenith of his reputation. His principles are immutable, his methods experimental, and many of them, though condemned by himself on trial, have been blindly perpetuated by injudicious disciples, to the disadvantage of elementary education and the detriment of Pestalozzi's fame.

Of these methods, however, some few which contained a richer and more fruitful germ, have developed into a world-wide utility. Among these may be mentioned the plan of simultaneous syllabic reading—of mutual instruction—of teaching form and number by concrete examples, which forms the basis on which Fröbel built up his famous superstructure of the Kindergarten—and lastly, the introduction of object lessons, which now enter largely into the programme of every good infant school. Of these, the first two were almost forced upon him by the circumstances of his position. Of simultaneous reading Pestalozzi says, 'The confusion arising from a number of children repeating at once, after me (their sole teacher at Stanz), led me to see the necessity of a measured pace in reading and speaking, and this measured pace heightened the effect of the lesson.' It was at Stanz also that he first adopted the plan, afterwards so largely adopted by Bell and Lancaster, of setting children to teach children. But Pestalozzi's plan was very different from what was known in England as the 'Monitorial System,' by which 'one child was drilled through an artificial machinery of lifeless tasks, and the child so drilled employed for pay to drill others in the same manner and by the same means.' 'Seeing that I had no assistant teacher,' says Pestalozzi, 'I placed a child of superior capacity between two others. He threw his arms round their necks; he taught them all they knew; they learned from him what they knew not; they sat by the side of each other with heartfelt affection; joy and love animated their souls; the life which was awakened in them, and which had taken hold of their minds, carried both teacher and learners forward with a rapidity and cheerfulness which this process of mutual enlivening alone could produce.'

Pestalozzi was in the habit of dividing the elements of knowledge into three branches—Language, Form, and Number. It is hardly necessary to point out that these three categories do not embrace the whole field of knowledge in its most elementary aspect. There are numberless phenomena which present themselves to the observation of a child which have nothing to do with language, form, or number, but for practical purposes Pestalozzi tells us he found this classification work well. Of his lessons in Language we have already learned something in former pages, but it is only fair to state the theory on which he intended language should be taught, though we may not be disposed to imitate his practice. The first step, he tells us, is to teach the child to distinguish articulate sounds and imitate them. The second is to teach him to name everything brought under his notice, in order to furnish him with a supply of words. The third is to teach him to distinguish and name the most striking parts, characteristics, and qualities of particular objects—to observe them with intelligence, and then express himself correctly in describing them. The fourth is to teach him to abstract, generalize, and classify in language. The fifth, and last, is to teach him to describe not only the qualities of objects, but their uses, combinations, and relative values; and to assign them their several places in the social economy of the world. In this way the habit of viewing the material world with

* It is only fair to state here in Pestalozzi's own words the method of teaching geography, which he believed to be the right one, and which has now been, in its general outlines, adopted by most intelligent teachers:—

'The instruction in this subject begins with the observation of the district in which we live, as a type of what the surface of the earth presents. It is then separated into elementary instruction (*a*) including physical, mathematical, and political geography, and (*b*) the topographical part, in which each of the departments of the subject, suggested by the observation of the surrounding district, is prosecuted in a graduated course, and then reciprocal bearings brought out. By this foundation the pupils are prepared for forming a clear and comprehensive view of the earth and man, of their mutual influences, of the condition of states and peoples. The children are made acquainted with the statistical portion of the subject, that is, the natural productions numbers of population, forms of government, etc., by means of tabular views.'

intelligence is excited and cultivated, and this combined with the power of correct and ready expression. 'Language,' Pestalozzi observes, 'is the reflex of all the impressions which Nature's entire domain has made on the human race. Therefore I make use of it, and endeavour, by the guidance of its uttered sounds, to reproduce in the child the selfsame impressions which, in the human race, have occasioned and formed these sounds. Great is the gift of language! It gives to the child in one moment what Nature required thousands of years to give to man.' Compare these observations with the statement of Pestalozzi's opinions in p. 227, and mark how, in dealing with the relations of words and things, this profound but irresolute thinker fluctuated between the two great schools of thought which have divided the world since the days of Plato and Aristotle.

Secondly, with respect to Form. Pestalozzi invented a few of those simple mechanical appliances by which the eye and touch of babies are taught to distinguish between round and square, a process which we find thus magniloquently described: 'He learns the data of the science from the examination of geometrical solids.' Under the head of form he included writing, drawing, and geometry, holding that the basis of each of these requirements was the perception of shape and dimension. Drawing ought to be an universal accomplishment, because it leads the child from vague perceptions to clear ideas. The art of measuring must, however, precede that of drawing. 'If a child,' says he, 'is called upon to imitate objects before he has acquired a distinct notion of their proportions, his instructions in the art of drawing will fail to produce on his mental development the beneficial influence which alone makes it worth learning.' Then, again, writing, he contended, should be taught, not before, but after drawing, 'for writing is, in fact, a kind of linear drawing, and that of fixed forms, from which no arbitrary or fanciful deviations are permissible.'* As to the method of imparting the last of the three Pestalozzian 'elements,' namely, Number, he thus writes himself: 'The rudiments of number should always be taught by submitting to the eye of the child certain objects representing the units. A child can conceive the idea of "two balls," "two roses," "two books," but it cannot conceive the idea of "two" in the abstract.' To this Dr. Mayo adds: 'When the child has been thus exercised in distinguishing and naming "one," "two," "three," the number of the different objects presented, he will soon have an intuitive perception that the terms "one," "two," "three" are always the same, while the objects, to which they are applied, vary; he will thus be prepared to separate the idea of number from that of the thing, and so ascend to the abstract idea. When he has a correct idea of the numbers up to ten, he is ready to carry on different combinations of these numbers. By practical examples, he learns to form rules for himself—he works his own way, acquiring power, vigour, and readiness at each advance; he is not led hoodwinked through the intricacies of arithmetic, but understands what he is about, first becoming acquainted with elements, and then enjoying the pleasure of finding the results of their various combinations. The whole is a reasonable exercise.' To conclude with a few words on the Pestalozzian method of teaching the elements of Latin, for which this seems to be the proper place. Dr. Mayo thus writes in one of the letters from which extracts were made in the last number: 'He does not begin with definitions, because children never comprehend them; but first, calling up the idea in the child's mind by conversing with him, he gives him the simple sentence "*leo est animal.*" Here the words *leo* and *animal*, being, one almost the same, the other quite the same as those which express the same ideas in English, they readily enter the child's mind. From this he proceeds to "*an ape is—what?*" "*an animal.*" "*Simia est—what?*" "*animal*," the child using the word he had learned just before. Proceeding in this manner he stocks the child's mind with words, before he enters on the inflexions of those words, always endeavouring to link what the child has to learn with what he has already acquired. In the declensions he does not propose to the child "*musa*, a Muse, *musæ*, of a Muse"—words which cannot interest the child, because they represent only parts of ideas—but he involves the important word in sentences, thus: "*rosa est flos amœnissimus horti*," "*rosæ odor est suavis*," etc., through all the cases The child having learned the inflexion of *rosa* has a similar word proposed to him, also enveloped in little sentences, but he is now required to find the termination. The advantages of this method are briefly these: you do not disgust the child with his first intellectual exertions, you exercise other faculties besides memory, you enrich his mind with a great number of ideas, and you furnish him with a *copia verborum* before you set him down to translate a classical author or to express his own ideas in a connected chain in the language.' He thus contrasts the above with the ordinary method of teaching language: 'In spite of every indication that the youthful mind spontaneously gives, that it is led from the perception of particulars to the conception of universal propositions—that it must first see embodied in realities and clothed with circumstances, the ideas which it is afterwards to recognise in their pure, abstract, intellectual form—the prevailing practice is forcibly to drive a child of tender years through the generalities of grammar, unintelligible and uninteresting to him, till at last in the course of their practical application, the true order of thought is established in his mind, and he understands and appreciates his grammar, through the knowledge which he derives from studying the language itself.'

The ideas thus enunciated were developed with well-known success in Dr. Mayo's own Pestalozzian school at Cheam. They lie at the bottom of the 'Hamiltonian' method, and of the 'Mastery System' of Mr. Prendergast, which is daily commending itself more and more to the minds of educationalists, as the true, rational, and scientific method; and, backed by his able and persevering advocacy, bids fair to revolutionize in the coming generation, the whole English system of teaching languages living and dead.

The foregoing is a very fragmentary and imperfect sketch of a subject on which volumes might be, and indeed have been, written—the *methods* of Pestalozzi. In the next and last article on his system, an attempt will be made to state and explain his *principles*.

(To be continued.)

* The principles of Pestalozzi's system of Geometrical instruction have been successfully and beautifully applied in 'The Lessons on Form' of Mr. Reiner, late of the Home and Colonial Training College.

'How I Teach Elementary Science.'

BY RICHARD BALCHIN,

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FOURTH-SCHEDULE SUBJECTS: MECHANICS.

PUBLIC curiosity was greatly excited on the occasion of the removal from my workshop to the school of the apparatus here illustrated. Two solemn-looking boys carried the large frame, tied to a pole borne on their shoulders, while two others walked by their side with the ropes, pulleys, screw, etc., round their necks. I brought up the rear. We all preserved the utmost gravity, while the giddy crowd of onlookers indulged in frivolous remarks. 'It is part of a bedstead,' said one; a profane vulgarity that caused me at once to adopt the Polyphemic stride peculiar to an elementary teacher when in deep thought. 'A model of a sort of gallows for hanging Fenians,' said another; at which the small boy with the ropes about his neck looked all the innocent anguish of a man on his way to a cruel execution. When the little mournful procession arrived at the school the apparatus had to be deposited in one of the school lavatories, where it will remain when not in use, until the long-rumoured reduction of salaries takes place, when, of course, it will have to be sold, along with all the other accessories of science teaching that I have managed to get together.

Probably some of my fellow-teachers have, like myself, one of their rooms fitted up as a workshop; of course I mean at their own private homes, not at the school. Those that have not I should advise to set about getting it at once. Some hard work at carpentering and the lathe will help to throw off the old and worn-out material of both body and mind. To those who possess a workshop the construction of this apparatus is easy. The outer frame is about four and a half feet high, three feet wide, and is made of one-and-a half-inch-square pine, mortised at the corners, and let in at the bottom to a much stouter piece. To give it greater steadiness, iron brackets may be placed at the rear of the uprights at the base. The lever (Fig. 1) is of the same material as the sides of the frame, four and a half feet in length, of uniform thickness, and weighs exactly two pounds. It is marked off into equal distances, counting from each side of the centre C. When in use it rests upon the handle V (Fig. 2) as a fulcrum. The pulleys T and U are ordinary brass screw-pulleys: they can be bought at any ironmonger's. S, R, and Q are the same, but the threads of the screws are filed off, and the remaining short piece of iron heated and bent to form a hook. The cord from T to U passes through the frame for greater convenience in showing the running down of the weight P. Where the cord passes through the frame I have let in a small piece of brass-piping jointed into iron plates on either side. Below F are two of the commoner kinds of block pulleys. The sheaves (wheels) are brass, the frames iron, and other details steel. They are really beautiful pieces of engineering work, made by the father of one of the boys. It took him two weeks of evening work to complete them, and I could not prevail upon him to take a single halfpenny for his trouble. He is an engineer. If any teacher is not able to get this done so cheaply, he can easily make it himself if he has a 'slide-rest' to his lathe. At G is seen the wheel and axle. For the two-grooved wheel H get a piece of two-inch pine, cut it roughly round, and turn it up on the taper-screw chuck of the lathe. Let the larger wheel be eight inches in diameter, and the smaller one two inches. They are both in one piece, and are three-quarters of an inch thick. Turn the axle to one inch in diameter. For bearings, run on to each end of the axle a piece of brass piping half inch on the outside; fit into the frame pieces of iron piping half inch in the inside. One end of the axle runs through the centre of the wheel, into which it is fixed by a wooden peg through the smaller wheel. The whole should run easily. A pound weight, J, suspended by a cord passing round the large wheel, should exactly balance a weight, I, of eight pounds upon the axle. Fig. 3 is the inclined plane, removed, however, from its place on the apparatus in order to show the large screw W. When the plane is in use the screw W and the block X are removed; then the lower end, A5, of the plane is placed at Z, and the upper end, A4, rests upon the brass rod of which the handle is V. This brass rod may be inserted into any of the holes represented, and thus give various elevations to the plane. These holes, which are three inches apart from centre to centre, are drilled through iron plates screwed on to the uprights. The length of the plane is a little over three feet, and the height of the top hole one foot. The little carriage A6, which is to carry the weights to be drawn up the plane, weighs exactly one pound: it has four brass wheels upon steel axles. The wheels are grooved to run upon two lines of iron rails screwed down to the plane: by this means there is so little friction that one penny piece at the end of a cord passing over the pulley, just above A 4, is sufficient to draw along the truck when the plane is level. A weight of five pounds placed in the truck should exactly balance a weight of two pounds at A 3 when the plane is in position, elevated to the top hole at V. At W (Fig. 2) I have arranged the screw. All that can be shown here is the enormous power gained by the use of this simple machine. It is an ordinary wooden bench-screw, which, with its block, can be bought at any ironmonger's. The block X slides easily backwards and forwards upon a smooth table that also serves to connect the lower part of the frame. The plain part of the screw near its shoulders Y turns in a plain bored hole in the fixed block Z. In actual working the shoulder is of course close up against this block. Looped on to the movable block X are two stout cords: these unite, and pass over the pulley A 1. Upon turning the handle or lever of the screw at Y the weight A 2 is raised. A little child has by means of this screw easily lifted one hundredweight. The graduated rod or lever (Fig. 1) can also be used as a scale. If, for instance, it be placed against the upright on the right-hand side of the frame, it will mark the distance to which the weight P falls, and the height to which O is raised thus serving to illustrate that whatever gain there is in power is accompanied by a corresponding loss in distance.

The cost of materials for such an apparatus is about thirty shillings; but any school-furnishing firm would probably charge about five pounds for the complete machine.

I will now reproduce a lesson upon 'the Lever,' to illustrate the use of this contrivance.

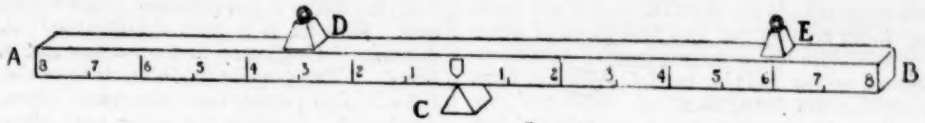

Fig. 1.

Fig. 2.

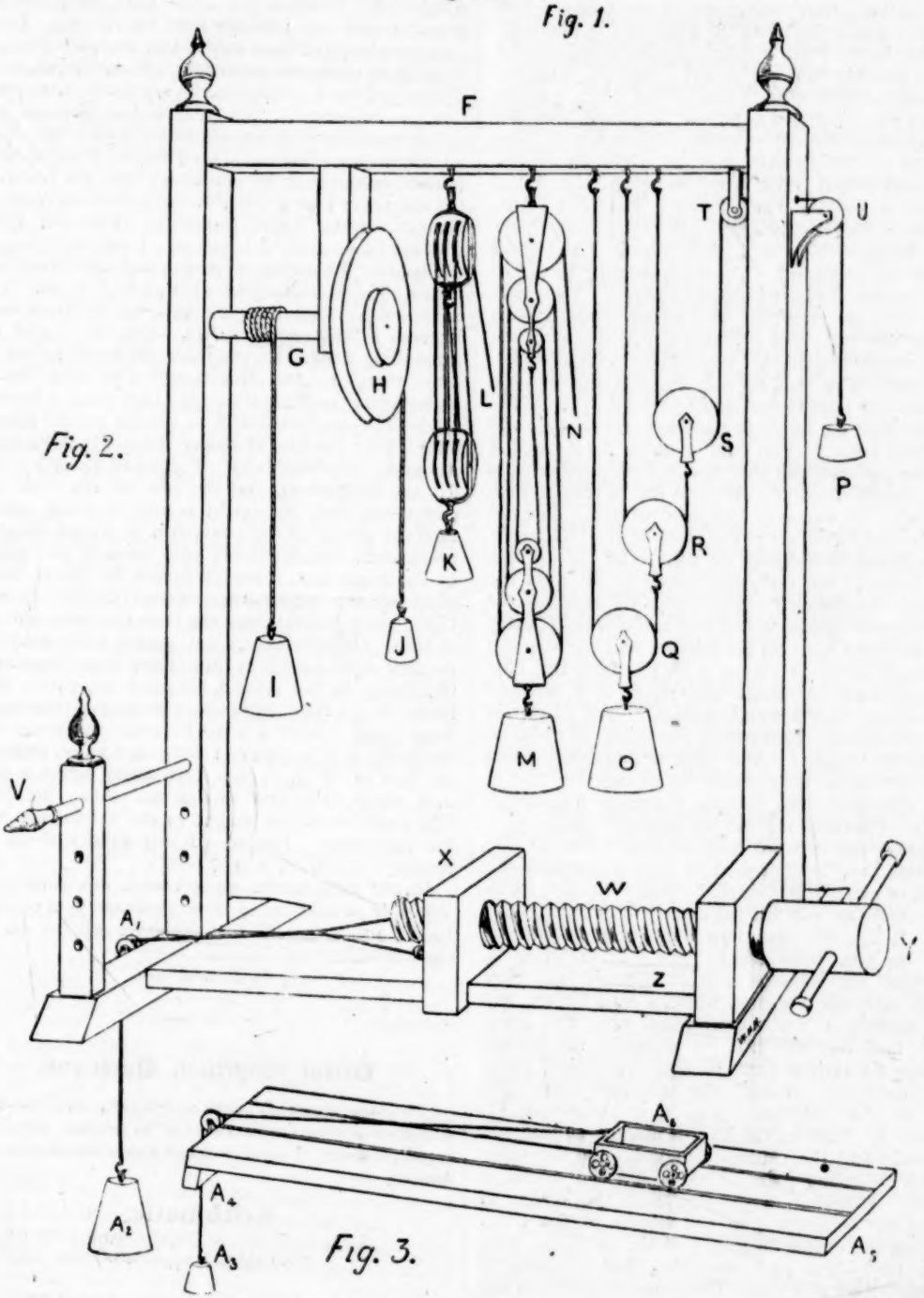

Fig. 3.

Jones, come out here, and try to lift that cupboard. You can't move it? Well, place the end of this rod a little way under it; now put this little block of wood under the rod close up to the cupboard; press down the other end of the rod; be careful. You see, boys, the cupboard is now being tilted up. Have you ever seen men lifting heavy things in that way? Ans.—Yes, sir: I saw a man getting up the flagstones in that way. (Another boy)—I saw a grocer getting a large barrel of sugar into his shop in that way. Just so. Embery, you seem stronger than Jones; come here; put the iron under the cupboard as before. Now I will bring the block a little farther out away from the cupboard. Now try to lift it. What! can't you move it? Ans.—No, sir; I can't shift it; there is not enough handle. What do you mean by 'not enough handle'? Ans. (Embery)—The distance from the block to my hand is not enough. Very well, then alter it. Ah! don't overturn the cupboard. You see how easily he tilts it. Try to lift the cupboard without the rod. You can't do it. You see, therefore, what an advantage there is in using this rod; and what must you do to lift the weight the more easily? Ans.—Have a long handle. Very good. Now you say that the distance from the block to your hand is the handle: what do you call the distance from the block to the other end of the rod? You don't know? You want a name for it; well, I will give you one, and also names for the other parts of this simple machine. Here is the picture of such a rod, with the names of the parts written. The rod itself is called a 'lever;' the block is the 'fulcrum;' the cupboard or whatever we want to lift we will call the 'weight;' the force you apply to lift it is the 'power;' the distance between the fulcrum and the power, which Embery called the handle, is the 'power-arm,' and that between the fulcrum and the weight is the 'weight-arm.' How much do you think that cupboard, with all the books and slates in it, weighs? Ans.—More than a hundredweight. Yes; I should think about two. Embery, do you think you could lift two hundredweight? Ans.—No, sir; not without that lever. (A boy)—He couldn't lift it *with* the lever at first. (Embery)—No, because there was not enough handle. (Teacher)—Don't say handle. (Embery)—The power-arm was not long enough. Just so. Do you think these boys pressed the lever downwards with a force of two hundredweight? Ans.—No, sir; much less. And can you tell me exactly how much less? Ans.—It depends upon how long the power-arm is. How do you know that? Ans.—From trying it, and from our common sense. Exactly so. Now we will carry our common sense a little farther, and after making a few experiments with this apparatus, find out the true or scientific relationship between the various parts of that mechanical power called the lever. Howell, you come here; place this lever on that fulcrum. (Fig. 1 is placed on V.) Balance it. You see the lever is marked so that you can easily find the centre. Do you know the name of that balancing point? (A boy)—The centre of gravity. (Another boy)—You said the centre of gravity was somewhere in the middle of the earth. Yes; so the centre of gravity of the earth is. (Another boy)—You said everything had a centre of gravity. And so it has. The centre of gravity of that lever is just about where Howell has balanced it. Now, Howell, put a four-pound weight on the lever, say three distances from the fulcrum. Hold up the lever. Smith, take this two-pound weight; put it on the other arm; see where it just balances. (Smith)—It balances now. How far is it from the fulcrum? Ans.—Six distances. Cox, come and write that on the black-board. 'Two pounds six distances from the fulcrum balances four pounds three distances.' Now take the weights off. Dedden, you come out; place this six-pound weight one distance from the fulcrum. Drayson, see where you have to put this two-pound weight in order to maintain equilibrium. Here it is, sir, three distances from the fulcrum. Very good. Cox, write that on the board. 'Six pounds one distance balances two pounds three distances.' Just so. Now all go to your places. Look, boys. I place eight pounds on the lever two distances from the fulcrum: tell me where I must put this two pounds in order to balance. Ans.—Eight distances. You are right. You see how exactly it balances. I will write that on the board. I want you all now to look upon the black-board. Think carefully of what we have done. Tell me whether, in these experiments, the results show a likeness in any respect. Ans.—Yes, sir: it's all the same thing. What do you mean, Richards, by 'all the same thing'? Ans. (Richards)—The arm that is shortest has the greatest weight. Very good. (Another boy)—The smallest weight is always on the longest arm. Yes; but that is almost the same as Richards has said. (Another boy)—If you call the arm on the left the weight-arm, and the one on the right the power-arm, then the weight is just as much greater than the power as the power-arm is greater than the weight-arm. (Howell)—If you multiply the weight by the weight-arm, it always equals the power multiplied by the power-arm. That's capital, Howell. Come out here, and show the boys that what you say is true. (Howell comes out greatly delighted.) In the first experiment four times three is the same as six times two; in the second, six times one equals twice three; in the third, eight times two equals twice eight. Very good. Now I want to write out these four quantities as a proportion: you can, I know, easily tell me how to do it, as you have lately heard a good deal about ratio and proportion. Ans. (Smith.)—The power is to the weight as the weight-arm is to the power-arm. Just so. I will write that on the board. 'P : W :: w.-a. : p.-a.'

In our next lesson we will work out some sums from this proportion. You may take out your exercise-books, and copy all that we have written on the black-board.

(To be continued.)

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Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.—(*dictated*).

(1) 846 + 35 + 978 + 867 + 429. Ans. 3155.
(2) From 810 take 26. Ans. 784.
(3) From 405 take 320. Ans. 85.

STANDARD II.—(*dictated: two sets*).

A (1) 67,894×85. Ans. 5,770,990.
(2) 40,016÷7. Ans. 5716–4.
(3) 41,302–34,067. Ans. 7235.
B (1) 67,894×94. Ans. 6,382,036.
(2) 40,016÷6. Ans. 6669–2.
(3) 41,302–40,819. Ans. 483.

STANDARD III.

(1) If 198 nuts be divided equally among 7 boys and 11 girls, how many will each receive? Ans. 11.

STANDARD IV.

(1) Multiply nineteen pounds thirteen and eightpence halfpenny by 109. Ans. £2145 14s. 2½d.
(2) If a man's wages are 3s. 7d. a day, and a boy's 1s. 3d. a day, how much will a farmer, who employs 8 men and 3 boys, pay per week of 6 days in wages? Ans. £9 14s. 6d.
(3) Divide £18,907 4s. 10d. (given in *words*) by 84. Ans. £225 1s. 8⅓d. – 64.
(4) In 763,972 inches (*words*), how many miles, fur., yds., etc.? Ans. 12 m. 0 f. 101 yd. 1 ft. 4 in.
(5) Subtract £12,907 17s. 6¾d. from £22,382 7s. 10½d. (*words*). Ans. £9474 10s. 3¾d.

STANDARD V.

(1) If 147 yards cost £4 11s. 10½d., how many yards can be bought for 8s. 1½d.? Ans. 13.
(2) 8 yds. 18 ft. 216 in. at £1 16s. a *foot*. Ans. £421 8s. 6d.
(3) Make out this bill—3 lb. of tea at 2s. 9d., 14½ lb. of sugar at 7½d., and 2½ dozen eggs at 1s. 1½d. a dozen. Ans. £1 0s. 1½d.

STANDARD VI.

(1) If 32 men mow 360 acres in 8 days, in what time could 48 men mow 1080 acres? Ans. 16.
(2) Reduce 4s. 3½d. to the decimal of £1 5s. 9d. Ans. ·16.
(3) Find the value of $\frac{1}{2\frac{1}{5}}$ of $\frac{3}{5}$ of $\frac{1}{8}$ of a ton. Ans. 4 lb.
(4) If a wheel be 5½ feet in circumference, how many times will it revolve in 7·875 miles? Ans. 7560.

Domestic Economy.

STAGE III.

(1) How would you treat a burn?
(2) Why would you not look sad in a sick-room?
(3) How would you roast a piece of beef?
(4) How would you boil a piece of beef?
(5) Name one thing that is necessary in a sick-room.
(6) What would you do to ventilate a sick-room?
(7) How would you treat meat in making broth?

Geography.

STANDARD III.

(1) What is on the north of England?
(2) Name a river that flows into the Irish Sea.
(3) Mention a river that rises in Plinlimmon.
(4) What is on the E. of England?
(5) Another name for the same?
(6) What river rises in Wales and flows into the English Channel?
(7) Name an island south of England.
(8) In what river is it?
(9) Other islands in the English Channel?
(10) To which country are they the nearer?
(11) What is south of Wales?
(12) Through which English county does the Dee run?
(13) In what lake does it rise?
(14) Through which counties does the Wye run?
(15) Where is the Isle of Man?
(16) What separates Anglesea from the next county?
(17) What is the county on the other side of Menai Strait?
(18) Name the highest mountain in that county.
(19) What town stands on the Dee?
(20) Name seaports on or near the Bristol Channel.
(21) What strait joins the English Channel with the North Sea?
(22) Name a town on Cardigan Bay.
(23) On what river is Liverpool?
(24) Through what counties does the Thames flow?
(25) What is Anglesea besides an island?
(26) What country is on the other side of the English Channel?

STANDARDS IV. TO VI.

(1) What is another name for Tasmania?
(2) Name the parts of Australia.
(3) What are they called?
(4) What is the chief town in Victoria?
(5) What is the chief town in New South Wales?
(6) Chief river in Australia?
(7) Between what lakes are the Falls of Niagara?
(8) What is the largest river in North America?
(9) Name the strait between Tasmania and Australia.
(10) How many islands form New Zealand?
(11) Name a town in New Zealand.
(12) What do we get from there?
(13) Why do people go there?
(14) What is the distance of Australia from England?
(15) What was Australia formerly called?
(16) Name some of our possessions on the west of Africa.
(17) Why not emigrate to that part?
(18) Name an island in the Pacific Ocean belonging to England.
(19) What do we get from Australia?
(20) Where is Canada?
(21) How did we get it?
(22) When did we get it?
(23) Name the provinces in Canada.
(24) Name some towns in Canada.
(25) What is Nova Scotia?
(26) Where is it?
(27) Name a seaport of Nova Scotia.
(28) Name some lakes in Canada.
(29) What group of islands are east of Australia?
(30) How many islands form New Zealand? Name them.
(31) What do we get from Mauritius?
(32) Where is it?
(33) Name an island east of Africa belonging to England.
(34) Name an island in the Atlantic belonging to England.

Practical Lessons on Insect Life.

BY THEODORE WOOD, M.E.S.,

Joint Author of 'The Field Naturalist's Handbook.'

No. XIII.—THE HOMOPTERA.

AS has already been mentioned in one of the earlier papers of this series, the *Homoptera* and the *Heteroptera* are often considered to form sub-orders only, being collectively known as *Hemiptera*. By those who follow this system they are respectively termed *Hemiptera-Homoptera*, and *Hemiptera-Heteroptera*. As, however, the distinguishing features of the two groups are very strongly marked, we will consider them as forming separate orders, to the first of which, the *Homoptera*, the present paper shall be devoted.

The *Homoptera* include a number of insects many of which appear to be totally dissimilar from one another, and it is not until we carefully examine the structural characteristics that we find them to possess any family resemblance. The distinguishing features of the order may be briefly summed up as follows.

In the first place, the structure of both the upper and the lower pairs of wings is of a similar nature, whence is derived the title of '*Homoptera*,' a word signifying 'same-winged,' and therefore very appropriate. These wings are membranous, the upper pair being slightly longer than the lower, which they entirely conceal when the insect is at rest. They do not overlap, however, the sutural margins running parallel with one another, just as is the case with the elytra of the *Coleoptera*.

The body is very convex, causing the wings to assume a rather curious position when not in use. This attitude is not easily described, but may easily be seen by an examination of one of the 'frog-hoppers' which are so plentiful in all parts of the country.

The mouth is situated on the lower surface of the head, and is furnished with a beak, or proboscis, by means of which the juices of the plants upon which the insect feeds can be imbibed into the system. This proboscis is merely a modification of the mandibles and the maxillæ, which are considerably elongated, and enclosed in the labrum, which forms a kind of sheath for the whole.

In all these insects the pupa is active, and generally bears a considerable resemblance to the perfect insect, the chief distinction, of course, lying in the absence of wings.

There is yet another characteristic of the insects of this order, however, and that a very important one, for upon it is based the present arrangement of the group. This is found in the structure of the tarsi, which, in the *Homoptera*, are never found to consist of more than three joints. They may, however, have less, and Mr. Westwood has divided the insects of the order into three groups, namely, those which possess three joints in the tarsi, those which have two joints, and those in which one joint only is to be found.

The first of these groups is scientifically known as the *Trimera*, and is sub-divided into three families, of two only of which we have representatives in this country. In all the insects of this group the antennæ are very short, and are terminated by a slight bristle.

Of the first family, the *Cicadidæ*, we have only one British representative, and that solitary exception is so rare that it is very seldom seen, even by working entomologists. This insect, the lower surface of which is represented in the accompanying woodcut, possesses no popular title, probably on account of its rarity, but is scientifically known as *Cicada anglica*.

Cicada anglica.

Many of the foreign cicadas, that is, as far as the males are concerned, possess the faculty of uttering a very loud and shrill cry, which is audible at a considerable distance. This sound is produced by a pair of tightly-stretched membranes found beneath the thorax, which are protected by a horny plate easily visible upon examination.

It has not as yet been ascertained whether our British *cicada* is musical or not, although the probabilities are that it is so. It is true that a specimen of the male insect was kept in captivity for a couple of days without being heard to utter a sound, but this period of time cannot be considered sufficiently long to warrant us in coming to any definite conclusion upon the subject. It is much to be hoped that the next person who is fortunate enough to meet with a male *cicada* will endeavour to set this mooted point at rest.

The female *cicada* is furnished with an ovipositor of rather curious form, resembling a double spear with strongly serrated edges. By means of this instrument the insect is enabled to bore a hole in the substances in which her eggs are to be deposited.

The larva dwells in burrows in the earth, which it excavates by means of the very powerful fore-limbs. These tunnels sometimes extend to a considerable depth, some of the foreign cicadas sinking their habitations more than three feet into the ground.

The representation of the cicada which accompanies this description shows very clearly the peculiar form of the head, which is common to all the insects of the family to which it belongs, and also illustrates the manner in which the proboscis is packed away beneath the body when not required for use. The form of the body, too, is very well depicted, and, were it not for the size, the woodcut would serve as a very efficient illustration of the lower surface of almost any of our British *Trimera*.

Of the second family of this group, namely, the *Fulgoridæ*, or Lantern-flies, we have no British examples, and, as our space will not allow us to describe any of the foreign *homoptera*, we must pass to the third and last family of the *trimera*, namely, the *Cercopidæ*.

These insects are more familiarly known by the title of 'Frog-hoppers,' as they are popularly termed when they have arrived at the perfect stage of their development, and by that of 'Cuckoo-spit,' by which they are generally known while yet in the larval condition.

There must be few, indeed, who have ever possessed the use of a garden, or enjoyed a country walk during

the summer months, who have not noticed the peculiar masses of frothy substance to be seen upon the stems of many plants, and which are frequently in such abundance as to completely drench the lower garments of the pedestrian.

This frothy secretion is popularly considered to be composed either of the saliva of the cuckoo or of that of the frog, to which notion are owing the popular titles both of the larva and the perfect insect. In reality, it is formed in a very singular manner.

Driving its beak into the skin of its food-plant, the grub extracts the juices which constitute its nourishment. When they have passed through the system, these juices are exuded in the form of the frothy substance with which we are so familiar, and which covers the entire body of the larva. At occasional intervals the bubbles of which this frothy mass consists resolve themselves again into a liquid form, a drop every now and then falling to the ground, while another slowly takes its place, following the first, after a time, in like manner.

In the insects of this group the hinder limbs are formed for leaping, and are endowed with truly wonderful powers. It has been calculated that by their aid one of these Hoppers can leap to a distance equal to seventy times its own length; much the same as if a man were to spring over four hundred feet of ground at a single bound.

In order that they may be enabled to obtain a firm purchase upon the ground while preparing for these wonderful leaps, the hinder tibiæ are armed with a number of sharp spines, which afford the requisite foothold.

None of the insects of this division possess the curious sound-producing apparatus found in the *cicadas*.

The most striking insect of this group is the Scarlet Hopper (*Cercopis sanguinolenta*), which may occasion-

Scarlet Hopper *(Cercopis sanguinolenta)*.

ally be seen resting on the leaves of the common bracken upon a sunny morning in the early summer. It is a remarkably handsome creature, which, once seen, can by no possibility be mistaken, the bold scarlet and black markings at once pointing it out from amongst its congeners.

This is by no means a rare insect, although it is very local, so much so, indeed, that it is often found to be confined to a few square yards of ground. Easily detected, on account of its brilliant colouring, it is by no means so readily captured, making one of its tremendous bounds at the slightest sign of approaching danger, and being quickly lost to sight among the herbage.

Many other frog-hoppers are known to inhabit this country, but they are, as a rule, so plain and insignificant to ordinary examination, and so similar to one another in their habits, that there is no necessity for us to expend space upon their description.

We will therefore pass to the next group of the *Homoptera*, namely, the *Dimera*, or those in which two joints only are found in the tarsi. This division includes the insects popularly known as Plant-lice, or Green Blight, and scientifically as *Aphidæ*, which are such terrible enemies to the horticulturist.

Aphis *(Winged form)*.

These little insects are by no means formidable individually, but become so from the vast numbers in which they are found. They are wonderfully prolific, and that in a manner quite different from that which is customary with insects in general.

Aphis *(Apterous form)*.

For, in these insects, the peculiar method of reproduction termed *Parthenogenesis* is strikingly exemplified. A female Aphis, kept entirely isolated from the other sex, will produce female young, and female young only, at the rate of fourteen or fifteen per diem, which, strange to say, pass through no preliminary stages of development, but are brought forth in a perfect condition, differing only in size from their parent. These in their turn give birth to a third generation, and so on. This strange method of reproduction has been known to extend over a space of several years, during the whole of which time no male aphis had been allowed access to the insects.

This will account for the wonderfully rapid rate at which the aphides increase, myriads appearing where only a few days previously not an example was to be seen. The birth of prolific females of course increases the reproductive powers to a wonderful extent, and there are few creatures which multiply with the extreme rapidity of the aphis.

Now and then the aphis does lay eggs, but this is the exception, and not the rule, the usual method of reproduction in this extraordinary insect being by the parthenogenesis above described.

Although individually an aphis can scarcely do any appreciable harm to a plant, the extraordinary numbers of the aphides render them a most terrible pest to agriculturists. There are few plants or trees to which some species of aphis does not attach itself, and which do not suffer very considerably from the ceaseless persecutions of its tiny foes.

The hop, especially, is a particular favourite with these little insects, and, were it not for the attacks of the ladybirds, the lacewing-fly, and many other insects which find in them their principal food, the cultivation of this plant would be an absolute impossibility. Gardeners, also, know only too well the ravages caused by the 'blight' upon many of their favourite flowers, and vainly exhaust their energies in devising means to extirpate their destructive foes.

Yet, by a marvellous provision of nature, the enemies of the blight seem always to appear in proportion to the numbers of the pest. If our walls and windows are overrun with ladybirds, we may be sure that the

blight has appeared in unusual numbers in the neighbourhood, and that its natural enemies have followed it in order to perform their appointed work of destruction. Sometimes, in the hop-grounds, these creatures may be seen literally in myriads, testifying by their numbers to the service they have rendered the agriculturist in destroying his terrible enemy.

The reader will remember that the frog-hoppers, which were described in the earlier portion of this article, exuded the vegetable juices which had passed through the system in the form of a mass of bubbles. The aphis behaves in a somewhat similar manner, ejecting the liquid through two minute tubes which project from the upper surface of the abdomen. The fluid, however, does not appear in the frothy form with which we are familiar in the case of the frog-hoppers, but is merely distilled into limpid drops of liquid, which successively fall upon the leaves on which the insect is resting.

This 'honeydew,' as it is termed from its sweetness, is a favourite beverage with ants, which, strange as it may appear, actually carry the aphides off to their nests, in order to procure an unfailing supply of the coveted dainty. Very often an ant may be seen upon the leaf of some plant or tree tapping an aphis gently with its antennæ, in order to induce the insect to exude a drop of the saccharine fluid, which is eagerly licked up as soon as it makes its appearance at the extremity of the abdominal tubes.

It is also said that the ants are in the habit of guarding their herds from the attacks of the hymenopterous parasites which are constantly seeking an opportunity of depositing their eggs in the bodies of their victims, and that they are always on the watch for the appearance of the winged parasite.

There are several kinds of aphis to be found in this country, but as all are very similar in habits it is needless to particularize any one species.

Closely allied to the preceding insects are those curious aphides which have received the generic title of *Eriosoma*, *i.e.*, 'wool-bodied,' for the reason that their bodies are covered with a substance resembling fine cotton wool. These creatures are popularly known as American Blight.

The woolly substance with which the bodies of these aphides is covered far exceeds in bulk the insects themselves, which it renders so light in proportion to their size that they are blown hither and thither by the least gust of wind. Should they once find their way to the branches of an apple-tree, the fate of that tree is sealed, unless immediate measures are taken for the extermination of the pest. Creeping into the crevices of the bark, the insects form a settlement, and quickly make their way over the entire tree, which speedily becomes overspread with the white cottony substance which covers the bodies of the aphides. Before very long, the tree fades, withers, and finally dies; why, no one can tell.

Mr. E. Newman tells us, in his well-known 'Letters of Rusticus,' that the only way of extirpating this destructive pest is by the free application of melted size to the affected trees, not even the smallest patch of the woolly substance being allowed to escape. This, he says, is far superior to the whitewash used in many orchards, which, besides being comparatively ineffectual, completely ruins the appearance of the trees.

In the winter-time the aphides retire to the earth at the foot of the tree in order to gain protection from the chilling cold. It is then advisable to turn over an inch or so of the soil upon every frosty day in order that the concealed insects may be killed by the exposure to the cold.

These aphides are not furnished with the abdominal tubes through which the honey-dew is distilled, that liquid being produced only by the insects of the preceding group.

The last of the three groups of the *Homoptera* consists of the *Monomera*, or those in which the tarsus is composed of a single joint only. These creatures, which are popularly known as Scale Insects, or Mealy Bugs, and scientifically as *Cocci*, are all included in a single genus.

These are in many ways most extraordinary insects, the females especially seeming actually to *deteriorate* as they approach the perfect condition. Indeed, when the final stage of their development is attained, the female *cocci* become, as Mr. Westward justly remarks, more like galls than living creatures, 'losing all trace of articulation in the body as well as of articulated limbs, and leaving inert and fixed masses of animal matter, motionless, and apparently senseless.'

During the earlier stages of their development the sexes are very similar in appearance, both being very active at this period of their existence. After some little time they insert their beaks into the bark of some twig, or the veining of a leaf, and remain motionless, increasing, meanwhile, very rapidly in size. In this position they pass the winter, at the end of which the males take to themselves wings, and fly away in search of their mates, while the females remain fixed as before.

The male *coccus* presents a very different appearance from his obese and unwieldy mate, being really quite a handsome insect. The body is of a deep red colour, while the two wings are of an opaque white, edged with a band of deep crimson. He is very much smaller than the female, and, indeed, presents so totally different an appearance that the two would never be taken for the same species.

The eggs deposited by the female are about two thousand in number, and are enveloped in a kind of woolly substance which entirely conceals them from view. As soon as they are laid the parent insect dies, her body flattens and becomes shrivelled and hard, and forms a kind of covering for the eggs, which are situated beneath it.

The British *cocci* are terrible nuisances to the gardener, more especially in hot-houses, where they wreak considerable havoc among the flowers. Some of the foreign species, however, are directly useful to mankind, the well-known Cochineal Insect (*Coccus cacti*) being one of these. From another species, the Lac Insect (*C. lacca*) we obtain our sealing-wax, and a peculiar kind of wax from a third, *C. ceriferus*. The British species, however, have as yet been brought to no practical use.

(To be continued.)

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THE SQUIRREL.

Music by T. CRAMPTON.

Lively. mf

1st TREBLE.
2nd TREBLE.
BASS.

1. You can't catch me! I live in a tree, High up a-bove the ground; I
2. My food, so good, I find in the wood: A-corns and nuts, all these, I
3. Who'll live with me, So jol-ly and free, And sleep in my lit-tle nest? "Oh,

KEY G. *Lively. mf* D. t.

take my rest In a lit-tle nest, So snug, and safe, and sound. I'm
tru-ly tell, I like twice as well As pie or bread and cheese. I
no!" you say, "Lit-tle squir-rel, good-day! I like my home the best." Ha!

f. G.

fond of fun— I romp and run A-bout from tree to tree; When
hide my food A-bout the wood, In a-ny hole or nook; When
ha! ha! ha! You'd want your mamma, If you did live with me: 'Tis

Symph.

you pass by, I'm up so high That none of you can see.
trees are bare, I know 'tis there, And have not far to look.
bet-ter by far to stay where you are, And leave me in the tree.

Symph.

ANSWERS TO

Pupil Teachers' Examination Paper.

MAY 27TH, 1882.

CANDIDATES.

Three hours and a half allowed.

Arithmetic.

MALES.

1. What sum of money will be required to pay the wages of thirty-one joiners for thirty-one weeks, at £1 9s. 11½d. per week?

31 joiners × 31 = 961 joiners for 1 week at £1 9s. 11½d.

	£	s.	d.
Cost of 961 at £1 each ... =	961	0	0
,, ,, 10s. ,, ... =	480	10	0
,, ,, £1 10s. each ... =	1441	10	0
Deduct ,, ,, ¾d. ,, ... =	3	0	0¾
	1438	9	11¼ Ans.

2. What should be gained from the produce of 673 cows, reckoning the produce of eleven cows at £122 7s. 0½d.?

Produce of 1 cow = £122 7s. 0½d. / 11 = £11 2s. 5½d.

	£	s.	d.
Produce of 673 cows at £1 each ... =	673	0	0
			11
,, ,, ,, £11 ,, ... =	7403	0	0
,, ,, ,, 2s. 6d. = ¼ val. at £1 =	85	7	6
,, ,, ,, £1 2s. 6d. .. =	7488	7	6
Deduct ,, ,, ,, ½l. ... ... =	1	8	0½
∴ Total profit ... ... =	7487	19	5½

3. A clothier purchases 46 yds. 3 qrs. 3 nails of Tweed at 3s. 4d. a yard, and pays the bill with a £10 bank note; what change ought he to receive?

	£	s.	d.
Value of 46 yds. at 3s. 4d. each =	7	13	4
∴ ,, 3 qrs. = ¾ of value of 1 yard =	0	2	6
,, 3 nls. = ¾ ,, 3 qrs. =	0	1	10½
	7	17	8½

∴ £10 − £7 17s. 8½d. = £2 2s. 3½d. Ans.

4. What should be the weekly gain from the produce of 673 cows, if the produce of one hundred and one cows be valued at £1,123 8s. 3½d. per year?

101 cows : 673 :: £1123 8s. 3½d. : ?

£1123 8s. 3½d. × 673 / 101 = £11 2s. 5½d. × 673 =

£7487 19s. 5½d. Ans.

5. In a certain parish a poor rate of 5d. in the pound yields the sum of £123 6s. 8d. If a second parish, with a rental equal to as much and a half again as the first, be added to it, how much will the rate on the united parishes require to be increased in order to produce £339 3s. 4d.?

Rental of first parish = £123 6s. 8d. / 5d. = £2960 / 2 = £5920

,, second ,, = £5920 × 1½ = £8880

,, united parishes ... ... = £14800

∴ New rate per £ = £339 3s. 4d. / 14800 = 5 14400/14800 d. = 5 9/37 d.

∴ The rate on the united parishes must be increased 1/37 d. Ans.

FEMALES.

1. Find the cost of eleven thousand two hundred and ninety-two articles at £56 3s. 10½d. each.

	£	s.	d.
Value of whole at £1 ... ... =	11292	0	0
			56
,, ,, £56 ... ... =	632352	0	0
,, ,, 2s. 6d. = ¼ val. at £1 =	1411	10	0
1s. 3d. = ½ ,, 2s. 6d. =	705	15	0
1½ = 1/20 ,, 1s. 3d. =	70	11	6
Total value ... ... =	634539	16	6 Ans.

2. What is the value of 53 tons 9 cwt. 2 qrs. 21 lbs. at £19 3s. 6d. per cwt.?

	£	s.	d.
Value of 1 cwt. ... ... =	19	3	6
			1069
,, 53 tons 9 cwt. ... =	20325	0	0
,, 2 qrs. = ½ value of 1 cwt. =	9	11	9
,, 14 lbs. = ¼ ,, 2 qrs. =	2	7	11¼
,, 7 lbs. = ½ ,, 14 lbs. =	1	3	11¼
Value of whole ... =	20511	5	1½ Ans.

3. What would be the cost of making a railroad 1772 miles 5 fur. 12 poles in length at £1159 10s. per mile?

	£	s.	d.
Cost of making 1 mile ... ... =	1159	10	0
			1772
,, ,, 1772 mls. ... ... =	2054634	15	0
,, ,, 4 fur. = ½ cost making 1 ml. =	579	15	0
,, ,, 1 fur. = ¼ ,, 4 fur. =	144	18	9
,, ,, 10 p. = ½ ,, 1 fur. =	36	4	8½
,, ,, 2 p. = ⅕ ,, 10 p. =	7	4	11¼
Cost of making whole ... =	2055402	3	4½ Ans.

4. Make out the following bill:—

441 pairs of blankets at 19s. 9d. per pair.
1953 yards of muslin at 1s. 6½d. per yard.
819 pairs of stockings at 1s. 9d. per pair.
2079 yards of calico at 10d. per yard.
1134 pairs of gloves at 3s. 3d. per pair.

	£	s.	d.
441 prs. at 19s. 9d. per pair ... =	435	9	9
1953 yds. at 1s. 6½d. ,, yd. ... =	150	10	10½
819 prs. at 1s. 9d. ,, pr. ... =	71	13	3
2079 yds. at 10d. per yd. ... ... =	86	12	6
1134 prs. at 3s. 3d. per pr. ... ... =	184	5	6
Amount of bill ... ... =	928	11	10½ Ans.

Grammar.

1. Parse all the verbs in the following:—

'Then come, my sister! come, I pray,
With speed put on your woodland dress;
And bring no book: for this one day
We'll give to idleness.' WORDSWORTH.

Point out the adjectives in the above, and state to what class of adjectives each belongs.

VERBS.

Come—intrans., irreg., *come, came, come*, imper., 2nd pers., sing., agr. with (*thou*).
come—same as above, intensifying the first 'come.'
pray—trans., reg., indic., pres., 1st pers. sing., agr. with *I* and gov. (*thee*).
put—trans. irreg. *put, put, put*, imper., 2nd pers. sing., agr. with (*thou*).
bring—trans. irreg. *bring, brought, brought*, imper., 2nd pers. sing., agr. with (*thou*).
will—irreg. defec. *will, would*, indic., pres., 1st pers. plur., agr. with *we*.
give—trans. verb, irreg. *give, gave, given*, infin. pres. gov. by *will*.

ADJECTIVES.

my—pronominal possessive adjective.
your— ,, ,,
woodland—distinguishing ,,
this— ,, ,,
one—numeral ,,
no—negative ,,

2. What is meant by the comparison of adjectives? Give examples of adjectives that do not admit of comparison.

By the comparison of adjectives is meant such an inflection of the adjective as increases or lessens the signification. There are three degrees of comparison—positive, comparative, and superlative. Of course those adjectives whose meaning can neither be increased nor diminished do not admit of comparison, as:—*extreme, perfect, entire, square. infinite, universal;* and all *numerals*.

3. In what ways is the gender of nouns distinguished? Give examples.

The gender of nouns is distinguished (1) *by different words*, as:—*king, queen; horse, mare; duck, drake.* (2) *by a different termination of the same word*, as:—*actor, actress; hero, heroine; peer, peeress.* (3) *By a word prefixed*, as:—*he-goat, she-goat; man-servant, maid-servant; male-child, female-child.*

Geography.

1. Name in order the river-mouths, bays, headlands, and principal seaports between Land's End and the North Foreland.

Beginning at Land's End we go eastwards passing Mount's Bay, Lizard Point, Falmouth and Harbour, Mouth of Tamar, Plymouth and Devonport on Plymouth Sound, Start Point, Dartmouth, Tor Bay, Mouth of Exe, Mouth of Axe, Portland Bill, Weymouth and Harbour, St. Alban's Head, Mouth of Avon, Poole Bay, Needles, Solent, Mouth of Test, Southampton, Portsmouth and Harbour, Selsea Bill, Mouth of Arun, Mouth of Ouse, Beachy Head, Mouth of Rother, Dungeness, Dover, S. Foreland, Deal, The Downs, Mouth of Stour, Ramsgate, N. Foreland.

2. Describe as fully as you can the position, appearance, climate, and productions of the Channel Islands.

The Channel Islands (Jersey, Guernsey, Alderney, and Sark) lie in the English Channel adjacent to the shores of France, and are officially included in the county of Hampshire. They consist almost entirely of granite rock, and sienite is quarried in Jersey and exported as granite.

The climate is mild, but moist, owing to frequent rains and the prevalence of sea-fogs.

Jersey and Guernsey produce fruits and vegetables in abundance, apples are largely grown and great quantities of cider are made. Potatoes are raised in large quantities, and both Jers y and Alderney are celebrated for a small kind of cow (called the Al lerney cow). Jersey exports a considerable quantity of butter and other dairy produce.

The fisheries of Jersey are valuable, and embrace the lobster, oyster, and cod, all of which are exported.

Ship-building is carried on to a considerable extent in the same island. Jersey is hilly and well watered; Guernsey level in the north, but hilly in the south, also well watered; but less generally fertile than Jersey.

3. Describe fully the courses of the Clyde, the Shannon, and the Dee.

If you know of two rivers bearing one of these names describe both.

If you can, draw a map to illustrate *one* answer, and insert the lines of latitude and longitude.

The *Clyde*, ninety-eight miles long, has its source 1400 feet above the sea in the central highlands of southern Scotland, and the upper part of its course is closely adjacent to some of the smaller tr butaries of the Tweed basin. It flows north-west through Lanarkshire, and near the county-town forms three considerable falls, by which it descends 230 feet within a distance of four miles. It is navigable below Glasgow, which is the limit of tide-water. The principal tributaries are the *Douglas* and the *Avon* on the left, and the *Calder* and *Kelvin* on the right bank.

The Shannon from Lough Allen flows S. and W., having on its right bank, Roscommon, Galway, and Clare; on its left bank, Leitrim, Longford, West Meath, King's County, Tipperary, Limerick, and Kerry, and falls into the Atlantic sixty miles below Limerick. It passes through L. Ree, and L. Derg, and receives the *Suck* which separates Roscommon from Galway.

The *Dee* in Aberdeenshire is eighty-seven miles long, and has its source in the Cairngorm group of mountains, at a height of 4060 feet above the sea—a greater elevation than that of any other river in the British Islands. The bed of the river has on that account a very considerable declivity, and its course eastward to the German Ocean is exceedingly rapid.

The *Dee*, in Kircudbrightshire, forty-five miles long, forms in its middle portion a long narrow lake called Loch Ken, ten miles in length, by from one-half to three-quarters of a mile in breadth, and falls into the Solway Firth.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

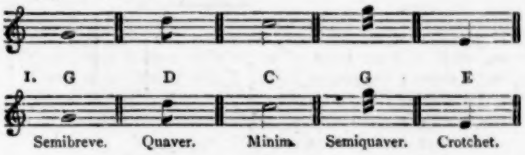
Write in large hand, as a specimen of copy-setting, the word *Pathetic*.

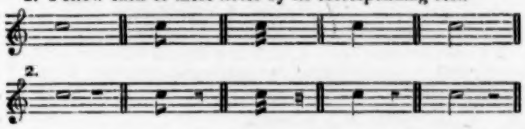
Write in small hand, as a specimen of copy-setting, *Englishmen know little of the French navy.*

Music.

A quarter of an hour allowed for this Paper.

1. Write over each of the following notes its pitch name (C, D, *De Re*, or other), and under each its duration name (crotchet, quaver, or other).



2. Follow each of these notes by its corresponding rest.

3. Supposing we make two beats while we sing a minim, how many shall we make while we sing a semibreve?

3. If we make *two* beats while we sing a minim, we shall make *four* while we sing a semibreve, because a semibreve is equal in duration to two minims.

FIRST YEAR.

Pupil Teachers at end of First Year.

Arithmetic.

Three hours and a half allowed.

MALES.

1. A penny is ·08975 inch thick; find the height of a pile of 1,000 pennies.

·08975 in. × 1000 = 89¾ in. = 7 ft. 5¾ in. Ans.

2. What decimal of 5 tons is 4 cwts. 3 qrs. 6 lbs.?

$$\frac{4 \text{ cwt. } 3 \text{ qrs. } 6 \text{ lbs.}}{5 \text{ tons}} = \frac{538}{11200} = \frac{5{\cdot}38}{112} = \frac{{\cdot}33625}{7}$$

= ·04803571428. Ans.

3. Given 17s. 6½d. as the price of 1¾ cwt., find the cost of 4½⅝ cwt.

1¾ cwt. : 4½⅝ :: 15s. 6½d. : ?

$$\frac{560\text{d.} \times 79 \times 4}{3 \times 16 \times 7} = \frac{1580}{3}\text{d.} = £2\ 3\text{s. } 10\tfrac{2}{3}\text{d.}$$ Ans.

4. I am owed a sum of £50 by each of two bankrupts, A and B, one of whom (A) can pay ⅞ of ⅞ of his debt, and the other (B) 10s. 4d. in the £. How much more should I get from one than from the other?

A can pay ⅞ of ⅞ or 49/64 of his debt = £39 1s. 6¼d.

B ,, 207/240 or 69/80 ,, = £39 7s. 6d.

∴ B pays 1/80 more than A

i.e. 1/80 of £50 = 1000/80s. = 2s. 4½d. Ans.

5. What fraction of the area of the floor of a room 30 feet square would be left uncovered by 133 yards of carpet ¾ of a yard wide?

30 ft. × 30 ft. = 900 sq. ft. = area of room.

133 yds. × ¾ × 9 = 2394/4 sq. ft. = ,, carpet.

3600/4 sq. ft. − 2394/4 sq. ft. − ¾ sq. ft. uncovered

i.e. 9/300 = 1/33 of the whole. Ans.

FEMALES.

1. If an income of £149 10s. is taxed at the rate of 5 pence in the pound, how much clear income will remain after the tax is paid?

Since 235d. is clear income out of £1, or 240d.,
then 240d. : 235d. :: £149½ : ?

$£^{299}_{2} \times \frac{235}{240} = £^{70265}_{480} = £146\ 7s.\ 8\tfrac{1}{2}d.$ Ans.

2. The carriage of 89 tons 15 cwt. for 120 miles cost £4 9s. 9d.; what will be the carriage of 29 tons 15 cwt. for the same distance?

1795 cwt. : 595 cwt. :: £4 9s. 9d. : ?

$\frac{1077d. \times 595}{1795} = 357d. = £1\ 9s.\ 9d.$ Ans.

3. If 35 bales of cotton, each weighing 120 lbs., cost 100 guineas, what will 20 bales of an inferior quality cost, each weighing 130 lbs., supposing 8 lbs. of the former to be worth 12 lbs. of the latter?

35 bales : 20 bales
120 lbs. : 130 lbs.
12 : 8
:: £105 : ?

$\frac{£105 \times 20 \times 130 \times 8}{35 \times 120 \times 12} = £^{182}_{9} = £43\ 6s.\ 8d.$ Ans.

4. If 5 needlewomen make 6 shirts in 4 days of 12 hours each, how long will it take 4 needlewomen to make 17 shirts, working 8½ hours per day?

4 women : 5 women
6 shirts : 17 shirts
8½ hours : 12 hours
:: 4 days : ?

$\frac{4 \text{ days} \times 5 \times 17 \times 12}{4 \times 6 \times 8\frac{1}{2}} = 20 \text{ days.}$ Ans.

Grammar.

1. 'Alas! too soon that pride was o'er,
Sunk with the lay that bade it soar.
His soul resumed, with habit's chain,
Its vices wild and follies vain.'—SCOTT.

(*a*) Parse all the pronouns in the above.
(*b*) How can you tell when the word '*that*' is a pronoun and when it is a conjunction?

(*a*) *that*—simple rel. pron., referring to 'lay,' 3rd pers., sing., neut., nom. to *bade*.
it—pers. pron., standing for 'pride,' 3rd pers., sing., neut., obj. gov. by *bade*.

(*b*) '*That*' is a pronoun when who, whom, or which can be substituted for it, as, *the lay that* (*which*) *bade it soar*.
'*That*' is a conjunction when it indicates a *cause*, a consequence or final end, as, *He works hard that he may gain the prize*.

2. Distinguish between possessive adjectives and possessive pronouns. Give examples of each.

Possessive adjectives (my, thy, his, her, its, our, your, their, own) are used with nouns only, as, *my* book, *his* hat.

Possessive pronouns (mine, thine, his, hers, its, ours, yours, theirs) are used when the noun to which they relate is not expressed, as, this book is *mine*, this pen is *yours*.

3. Some adverbs are formed from nouns, some from adjectives, some from pronouns. Give a few examples of each.

Adverbs are formed:—

From nouns—*needs, straightways, noways, whilom, meantime*.
From adjectives—*twice, unawares, formerly, much, little*.
From pronouns—*here, hither, where, why, whence, thence, the, there*.

Geography.

1. Draw a full map of Russia in Europe, and insert the lines of latitude and longitude.

2. Trace minutely the courses of the Elbe, the Oder, and the Vistula, mentioning in order, the tributaries and towns connected with each of them, and describing the character of the country through which they flow.

The *Elbe* rises in the Riesen-gebirge, at an elevation of 4,400 feet, flows south through a wild narrow valley, bends north-west, and is joined by the Moldau. Flowing north, it is joined by the Eger, enters Saxony, and is joined successively by the *Mulde, Saale, Havel*, and *Spree*. Between Hamburg and Harburg, the river is divided into several arms, enclosing some large islands, but these arms soon afterwards unite, and the Elbe enters the Atlantic in one stream; its total length being about 600 miles.

The basin of the Elbe is at first an elevated plateau formed by the mountains of Bohemia, possessing vast forests and rich mines. In Saxony, the district is hilly, rich in minerals, and has beautiful scenery and a fertile soil.

The towns on the Elbe basin are Budweis, Prague, Carlsbad, Dresden, Wittenburg, Chemnitz, Jena, Leipzig, Halle, Magdeburg, Berlin, Hamburg, Altona, and Cuxhaven.

The *Oder* rises in Moldavia, at an elevation of about 1,800 feet, runs north-east until it leaves Austria, when it turns north-west. It continues in this direction with a very winding course, until it is joined by the *Lower Neisse*, then flowing northwards it is increased by the waters of the *Wartha*, and falls into the Great Haff. The Wartha, which is its most important tributary, is augmented by the *Netze*.

The Oder drains Pomerania, Posen, and Silesia. Pomerania is for the most part a sandy plain, covered with heaths and forests. Agriculture is in a backward state. Posen is naturally more fertile, but agriculture is not more advanced than that of Pomerania. Silesia rears a great number of sheep, and is exceedingly rich in minerals, especially in the mountainous districts of the south-east.

The towns in its basin are Oppeln, Glatz, Neisse, Breslau, Liegnitz, Frankfort, Posen, Stettin, Swinemund.

The *Vistula* rises in the Carpathian mountains, flows first north then north-east, till it is joined by the *San*; it then turns northwards and is joined by the *Bug*. Now bending to the north-west it continues in that direction to Thorn, when turning again to the north, it falls into the Baltic. The Vistula flows through a district forming a part of the great European plain. The country is flat, and hence the river is navigable throughout the greater part of its course. The river discharges its waters by three mouths, two of which open into the Frische Haff, but the main stream flows into the Gulf of Dantzic.

The towns in the basin of the Vistula are Cracow, Warsaw, Thorn, Bromberg, Graudenz, Marienburg, Elbing, Dantzic.

History.

1. When did Edward the Martyr, Harold II., and William and Mary ascend the throne?

		A.D.
Edward the Martyr ascended the throne		975
Harold II.	,,	1066
William and Mary	,,	1689

2. Who were the immediate successors of Richard III., Edward VI., George II., and William IV.? Give dates.

				A.D.
The immediate successor of Richard III. was		Henry VII.	...	1485
,,	,,	Edward VI.	,, Mary ...	1553
,,	,,	George II.	,, George III. ...	1760
,,	,,	William IV.	,, Victoria ...	1837

3. How many kings named Edward, reigned between the Norman Conquest and the fifteenth century? Tell their dates of accession.

		A.D.
Edward I.	ascended the throne	1297
Edward II.	,, ,,	1307
Edward III.	,, ,,	1327

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Pathetic*.

Write, in small hand, as a specimen of copy-setting, *Englishmen know little of the French navy*.

Music.

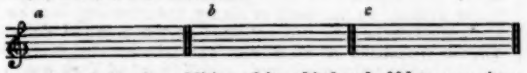
A quarter of an hour allowed for this Paper.

1. What is meant by *sound*, what by *tone*; and how does a sound differ from a tone?

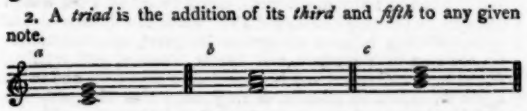
1. *Sound* is the effect on the ear of the vibration of the air caused by some disturbing force. When the vibration is regular, the result is a *musical* sound.

A *tone* is the interval between two sounds, either higher or lower, and can be divided into two semitones.

2. What is a *triad*? Write in *a*, *b*, and *c* severally the triads of (C) *Do*, (F) *Fa*, and (G) *Sol*.



2. A *triad* is the addition of its *third* and *fifth* to any given note.



3. How many tones and how many semitones are found in the diatonic scale, and what are the places in it of the latter?

3. Five tones and two semitones, the latter being found between the third and fourth, and seventh and eighth notes.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Of three bankrupts, A, B, and C, A can pay 77·5 per cent. of his debts, B 15s. 1d. in the £, and I accept from C £390 instead of £500 which he owes me. How much better do I come off than the creditors in a like sum of A and B respectively?

A pays $\frac{77\frac{1}{2}}{100}$ or $\frac{31}{40}$ of £500 = £387 10s. 0d.
B ,, 15s. 1d. × 500 = £377 12s. 8d.
C ,, £390 0s. 0d.

i.e., I come off better than the creditors of A by £2 10s. 0d.
,, ,, ,, ,, ,, B ,, £12 18s. 4d.

2. How long should £1200 at 4 per cent. be lent in return for the loan of £1920 at 5 per cent. for one year and a half?

$$\left.\begin{matrix}£1200 : £1920 \\ 4 : 5\end{matrix}\right\} :: 1\tfrac{1}{2} \text{ yrs.} : ?$$

$$\frac{3 \text{ yrs.} \times 1920 \times 5}{2 \times 1200 \times 4} = 3 \text{ yrs.} \quad \text{Ans.}$$

3. What is the rate of interest per cent. per annum if I pay £2 10s. 7½d. for the use of £300 for a month?

$$\left.\begin{matrix}£300 : £100 \\ 1 : 12\end{matrix}\right\} :: £2\ 10\text{s. } 7\tfrac{1}{2}\text{d.} : ?$$

$$\frac{£2\ 10\text{s. } 7\tfrac{1}{2}\text{d.} \times 100 \times 12}{300} = 10\tfrac{1}{2} \text{ per cent.} \quad \text{Ans.}$$

4. If a boy's father lends £55, and receives 55s. interest per annum for his loan, and the boy lends 55s. at the same rate of interest, how much should the latter receive at the end of a year?

55s. of interest on £55 = 1s. per £ = $\frac{1}{20}$ of money lent.
∴ the boy should receive $\frac{1}{20}$ of 55s., or 2s. 9d. Ans.

5. What is the average daily attendance of a school of 420 children for a week (= 10 half-days), if 15 per cent. of the scholars absent themselves on Monday forenoon and the rest of the week; and, besides them, there is a number of truants, increasing by 2 a time at each subsequent meeting of the school?

Mon.	A.M. meeting	= $\frac{85}{100}$ of 420	= 357;	P.M.	357 − 2	= 355
Tues.	,, ,,	355 − 2	= 353;	,,	353 − 2	= 351
Wed.	,, ,,	351 − 2	= 349;	,,	349 − 2	= 347
Thur.	,, ,,	347 − 2	= 345;	,,	345 − 2	= 343
Fri.	,, ,,	343 − 2	= 341;	,,	341 − 2	= 339
Total	,, meetings	... ...	= 1745;	,,	meetings	= 1735

$$\frac{1745 + 1735}{10} = \frac{3480}{10} = 348 \text{ average attendance.}$$

FEMALES.

1. Divide $\frac{7(1\frac{1}{2} \text{ of } \frac{9}{14})}{\frac{1}{9}\left(\frac{3}{3\frac{1}{2}} \text{ of } 7\right)}$ by $\frac{9}{14}$, and find the value of $\frac{\frac{1}{2} + \frac{1}{3} + \frac{1}{7}}{2\frac{1}{6} + 3\frac{1}{2} + 4\frac{1}{3}}$

(*a*) $\frac{7(\frac{3}{2} \times \frac{9}{14})}{\frac{1}{9}(7 \times \frac{7}{1})} \times \frac{14}{9} = \frac{7}{1} \times \frac{3}{2} \times \frac{9}{14} \times \frac{9}{1} \times \frac{7}{1} \times \frac{1}{7} \times \frac{14}{9}$

$= \frac{7}{1} \times \frac{3}{2} \times \frac{9}{14} \times \frac{9}{1} \times \frac{7}{1} \times \frac{1}{7} \times \frac{14}{9}$

$= 3\frac{1}{2}$. Ans.

(*b*) $\frac{\frac{1}{2} + \frac{1}{3} + \frac{1}{7}}{\frac{2}{6} + \frac{7}{2} + \frac{3}{3}} = \frac{6 + 4 + 3}{30 + 42 + 54} = \frac{13}{126}$. Ans.

Note.—Multiply numerator and denominator by $\frac{1}{42}$.

2. A man gave 15 tons of coal amongst the poor, giving to each 1½ cwt., among how many persons did he divide it?

$$\text{No. of persons} = \frac{15 \text{ tons}}{1\frac{1}{2} \text{ cwt.}} = \frac{300 \text{ cwt.}}{\frac{3}{2} \text{ cwt.}} = \frac{900}{5} = 180 \text{ persons.} \quad \text{Ans.}$$

3. A owned ⅔ of a farm of 300 ac.; he sold ¾ of his share to B; and B sold ⅓ of his share to C; what is the value of C's land at £50 an acre?

£50 × ⅓ of ¾ of ⅔ of 300 ac. =

$$\frac{£50 \times 1 \times 2 \times 300}{4 \times 3 \times 5} = £50 \times 20 = £1000. \quad \text{Ans.}$$

Grammar.

1. '*It* is not now, as it *hath been of yore*;
Turn whereso'er I may,
By night or day,
The *things which* I have *seen* I now can *see no more*.'
WORDSWORTH.

(*a*) Point out the conjunctions in the above, and state to which class of conjunctions each belongs.

(*b*) What kind of sentences are joined to principal sentences by relative pronouns? Illustrate your answer from the above, and give other examples.

(*c*) Parse the words in italics.

(*a*) *As*—subordinative (adv.); *or*, co-ordinative (alternative) conj.

(*b*) *Adjective* sentences are joined to principal sentences by relative pronouns; as, '*which I have seen*;' I met one *whom I knew*. This is the best example *that I can find*.

(*c*) *It*—pers. pron. used indefinitely, 3rd pers. sing. neut. nom. to *is*.
turn—reg. intrans. verb, infin. pres. indef., gov. by *may*.
hath been—subst. verb irreg. *am, was, been*, indic. pres. perfect. 3rd pers. sing. agr. with *it*.
of—prep. gov. obj. case *yore*.
yore—abstr. noun, neut. sing., obj., by *of*.
of yore—an adverbial phrase.
things—com. noun, neut. plur., obj., gov. by *see*.
which—simple rel. pron., referring to '*things*,' 3rd pers. plur., neut., obj., gov. by *have seen*.
seen—complete part. of irreg. verb, *see, saw, seen*, forming a compound tense with *have*.
see—irreg. trans. verb, *see, saw, seen*, infin., pres., gov. by *can*.
no—neg. adv., mod. *more*.
more—adv. of time, mod. *see*.

2. Make three sentences with *for*, *but*, and *except* used as conjunctions, and three in which they are used as prepositions.

CONJUNCTIONS.

1. Prince Edward fled, *for* the battle was lost.
2. He lived in hope, *but* hope was vain.
3. *Except* ye repent, ye shall all likewise perish.

PREPOSITIONS.

1. Choose out a path *for* me.
2. They all perished *but* him.
3. All the girls passed *except* her.

Geography.

1. Draw a full map of Russia in Europe, and insert the lines of latitude and longitude.

2. Give notes of a lesson on *Mountain Ranges* under these heads:—

(*a*) What is a mountain?
(*b*) What is a range?
(*c*) What is meant by 'the line of perpetual snow,' and what is the cause of it?
(*d*) How do mountains form *boundaries* and *watersheds*?
(*e*) Why do great rivers generally rise in mountains?

Illustrate each of these points as you come to it, from the mountains of Hindostan or British North America.

N.B.—Go *fully* into the examples you mention; do not merely give a string of names.

Notes of a Lesson on *Mountain Ranges*.

(*a*) *What is a mountain?*—A piece of land rising high above the level of the earth's surface, generally applied to elevations over 2,000 feet high—as, Dhawalagiri, 26,826 ft.; Everest, 29,002 ft.; and Kunchinjunga, 27,815 ft.; the highest summits of the Himalayas.

(*b*) *What is a range?*—When mountains extend in lines they are called mountain ranges, or chains; as the *Himalayas* range, running along the northern boundary of India—and the Aravulli Mountains separating the basins of the Ganges and Lower Indus.

(*c*) *Line of perpetual snow, and cause of it.*—The more elevated a place is, the lower is its temperature, and a change of only a few feet will diminish the temperature of a place as much as a change of latitude amounting to many miles. By continuing the ascent in any latitude we at length arrive at what is called the *snow line*, or the *limit of perpetual congelation*. In the tropics this line attains its maximum elevation, and gradually descends as it proceeds to the poles. The height of the snow line is not regulated exclusively by the degree of latitude, but depends very much on the exposure of the place, the character of the prevailing winds, and the depth of snow that has fallen during the winter. For example, the height of the snow line on the south side of the Himalayas is 16,200 ft.—on the north side 17,400 ft.

(*d*) *How do mountains form 'boundaries' and 'watersheds'?*—By forming a natural wall to enclose valleys, mountains serve as boundaries to separate countries and nationalities; thus the *Eastern Ghâts*, on the Coromandel coast, form the E. margin of the plateau of the Dakhan, and the W. Ghâts form the W. wall of the same table-land. On this table-land the languages are essentially different from the dialects of Northern India, showing clearly that mountains form a barrier of communication.

Again, the W. Ghâts form the water-parting as well as *watershed* between the Arabian Sea and the Bay of Bengal, just as the Aravulli Mountains separate the basins of the Ganges and lower Indus, or the Vindhya Mountains separate the Jumna from the Nerbudda.

(*e*) *Why great rivers generally rise in mountains.*—Currents of moist air striking against mountain-sides are driven up towards the summits. As the elevation increases the cold proportionately increases, whence condensation ensues. Mountain regions are thus the source of springs and streams, which, as brooks or torrents, run down the slopes into the valleys and are collected by the main stream as it pursues its way, rapidly or slowly, according to the aspect of the country. For example, the Ganges rises from under a low arch called the 'Cow's Mouth' at the base of a mass of frozen snow, about 14,000 feet above the level of the sea; the Indus rises at an elevation of 18,000 feet and is augmented by five rivers, all taking their rise in the Himalaya range.

SECOND PAPER.

Two hours and a half allowed.

History.

1. Write a short history of the queens of Edward III. and Henry VI.

Philippa of Hainault was the Queen of Edward III. She was a lady of distinguished virtue and heroic courage. During Edward's absence in the French Wars she defeated the Scots at Neville's Cross, and took David, the Scotch king, prisoner (1346). Next year she was present at the Capitulation of Calais, when six of the principal burgesses appeared before Edward to be hanged, according to the terms of the capitulation. The queen, by her entreaties, induced Edward to pardon them and they were set free.

Margaret of Anjou was the Queen of Henry VI. She was high-spirited, ambitious, courageous, and energetic; she was an excellent mother and a most heroic queen. During the Wars of the Roses she bravely raised troops in the cause of her husband. She rejected the arrangement that the crown should fall to the Yorkists on the death of Henry, and returning from Scotland, whither she had fled, collected 20,000 men and defeated York at Wakefield. At St. Albans (1461) she defeated Warwick; but she had to retire northwards, and Edward of York was proclaimed by the title of Edward IV. Immediately after his being accepted king, he marched against Margaret, who had collected 60,000 men in Yorkshire, met her at Towton, and totally defeated her. Margaret and her son fled to Scotland, and in 1464 again attempted an invasion of England, but at Hedgeley Moor and Hexham her forces were routed and dispersed. Margaret escaped, and it is said that she was assisted by one of a band of robbers to make her way over to Flanders. Once more she landed in England, and her small French force being augmented by an army in the west, she met Edward at Tewkesbury (1471). Here she lost her last battle and the life of her young son, who was foully murdered after the fight. Margaret was imprisoned in the Tower, but being ransomed by Louis XI. she was set free, and died (1482).

2. Give the date of the accession of Queen Anne. For what war was this reign remarkable, and what were the chief battles in which the English took part?

Anne ascended the throne in 1702. Her reign is remarkable for the 'War of the Spanish Succession.' The chief battles in which the English took part were Blenheim (1704), Ramillies (1706), Oudenarde (1708), and Malplaquet (1709).

3. What can you tell about the First House of Commons, the Battle of Evesham, and the Mad Parliament?

The First House of Commons met in the reign of Henry III., 1265. It was called by the Earl of Leicester, and for the first time *knights* and *burgesses* were allowed to sit in council with the barons.

In this reign, the king having, by his preference for foreigners, roused the indignation of the barons, was forced to call a council to redress the grievances of the nation. The measures laid down by this council were so 'madly' opposed to the royal authority that the king's supporters named it the 'Mad Parliament' (1258).

In 1265 Prince Edward, son of Henry III., escaped from the guards set over him by Simon de Montfort, raised an army, and defeated the great earl at Evesham. Earl Simon was slain, and great severity shown to the vanquished leaders.

Composition.

Write full notes of a lesson on *Leather and its uses.*

THINGS TO BE SEEN.—*A piece of raw, dry hide—slaked lime—glue—oak-bark—ground oak-bark*—and other things connected with the manufacture of leather.

1. WHAT IT IS.—Leather is made from the skins and hides of animals, such as bullock, doe, buck, bear, kid, chamois.

2. HOW MANUFACTURED.—Skins *cleaned* by cutting off horns, tail, and thin edges; by soaking and kneading them in water to make them soft, then by stirring them about with water containing slaked lime; hair scraped off, lime washed out; skin then scraped clean from fat, blood-vessels, and bits of flesh. These skins next *tanned*, that is, thrown into pits and stirred now and then for several months with water and chips of oak-bark; tanning hardens the gelatine (glue) and so makes the skin hard and less acted on by water; after this, hides removed, dried, and placed between rollers. After tanning, the leather comes into the hands of the *currier*, who damps it, pares the surface till the leather is of equal thickness throughout; then wets, puts it on a slate table, scrapes it, brushes it, hangs it up to dry, rubs it with a mixture of soot and tallow and fish-oil;—this makes the leather soft and pliable for working.

USES.—Leather is used for boots and shoes, gloves and riding trousers, coverings for chairs and sofas, for binding books, for some kinds of aprons, for harness, straps, bags, belts, and other things which can be named by the children.

Euclid.

MALES.

[All generally understood abbreviations for *words* may be used.]

1. Define *point, figure, semicircle, scalene triangle, parallel, straight lines, postulate, axiom.*

A *point* is that which has position but not magnitude.
A *figure* is that which is contained by one or more boundaries.
A *semicircle* is the part of a circle cut off by a diameter.
A *scalene triangle* has three unequal sides.
Parallel straight lines are such as are in the same plane, and which being produced ever so far both ways do not meet.
A *postulate* is a self-evident problem, the use of which is at once granted if required. The three postulates are: 1, The drawing of a straight line from one point to any other point; 2, The producing of a straight line to any length in a straight line; and 3, The drawing of a circle from any centre at any distance from that centre.
An *axiom* is a self-evident proposition.

2. To draw a straight line perpendicular to a given straight line from a given point without it.

Euclid I. 12.

3. To make a triangle of which the sides shall be equal to three given straight lines, but any two whatever of these must be greater than the third.

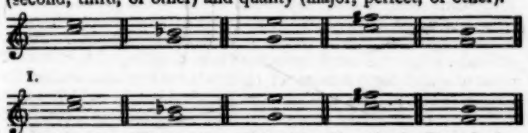
Euclid I. 22.

Needlework.

One hour allowed for this Exercise.

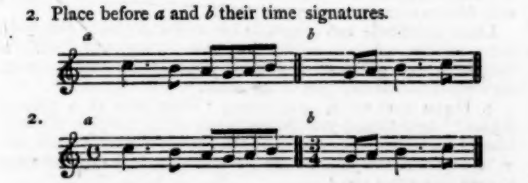
Music.

A quarter of an hour allowed for this Paper.

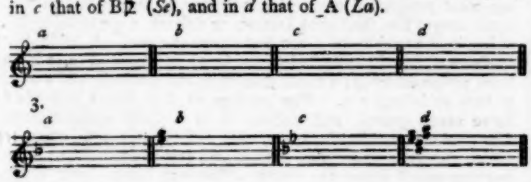
1. Write under each of the following intervals its name (second, third, or other) and quality (major, perfect, or other).

1.

Major 3rd. Minor 3rd. Major 6th. Pluperf. 4th. Pluperf. 4th.

2. Place before *a* and *b* their time signatures.



3. Write in *a* the scale signature of F (*Fa*), in *b* that of G (*Sol*), in *c* that of B♭ (*Se*), and in *d* that of A (*La*).



THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after,* **1st May, 1878; and Pupil Teachers at end of Fourth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

Arithmetic.

MALES.

1. What number is that from which, if 5 per cent. be subtracted, $\frac{1}{19}$ of the remainder is equal to 17?

5 per cent. $= \frac{1}{20}$ of the number.
i.e., $\frac{19}{20}$ of the No. remain.
$\therefore \frac{1}{19}$ of $\frac{19}{20}$ of the No. $= 17$
$\frac{1}{20}$,, $= 17$
or No. $= 85$. Ans.

2. The West Riding contains 1708026 acres, and the county of Durham 622476 acres, their populations being respectively 1507511 and 509018; which is the more thickly populated, and by how much per cent.?

Answer to two places of decimals.

Average pop. for West Riding $= \frac{1507511}{1708026} = .8826$ pers. per acre.
,, ,, Durham $= \frac{509018}{622476} = .8177$,, ,,
West Riding is more thickly populated by .0649 ,, ,,
that is, $.0649 \times 100 = 6.49$ per cent. Ans.

3. What incomes will be derived from (*a*) £5500 at $3\frac{1}{2}$ per cent. stock purchased at par, and (*b*) £5500 invested in the same stock at $102\frac{1}{2}$ respectively? And what fraction is the lesser income of the greater?

(*a*) $\frac{£5500 \times 3\frac{1}{2}}{100} = £192\frac{1}{2} = £192\ 10s.$

(*b*) $\frac{£5500 \times 3\frac{1}{2}}{102\frac{1}{2}} = \frac{£5500 \times 7 \times 3}{308 \times 2} = £\frac{11550}{56} = £187\ 10s.$

$\frac{187\frac{1}{2}}{192\frac{1}{2}} = \frac{375}{385} = \frac{15}{77}$ fraction required. Ans.

4. State and explain the rules for converting recurring decimals into vulgar fractions, taking .629 and 2.4114583 as your examples.

Rule for reducing a Circulating Decimal to a Vulgar Fraction:—
If only the same figures recur, make the repeating part the numerator of the fraction, and place underneath it as many nines as there are digits in the repeating part.

For example:—Let S represent the sum of the series .629629629.....

Then (*a*) 1000 times S = 629.629629.....
But (*b*) S = .629629.....
Subtracting (*b*) from (*a*) 999 S = 629
$\therefore$ S $= \frac{629}{999} = \frac{17}{27}$ in L. T.

But if it be a mixed circulating decimal, subtract the digits which do not recur from the whole expression as far as the end of the first repeating part; take this difference as the enumerator, and for the denominator place as many nines as there are figures in the recurring part, followed by as many ciphers as are figures in the part which does not recur.

For example:—Let S again represent the sum of the series, 2.411458333.....

(*a*) Then 10000000 times S = 24114583.33 .....
(*b*) And 1000000 ,, S = 2411458.33.....
Subtracting (*b*) from (*a*) 9000000 ,, S = 21703125
$\therefore$ S $= \frac{21703125}{9000000} = 2\frac{79}{144}$.

5. If $3\frac{1}{2}$ per cent. consols are at $86\frac{1}{2}$, and $4\frac{1}{2}$ per cent. railway stock at $94\frac{1}{2}$, which is the better investment? And what amount should I then invest in the consols so as to obtain an income equal to that which would arise from £1050 invested in the railway stock?

(*a*) In the 1st case an expense of £$86\frac{1}{2}$ yields £$3\frac{1}{2}$
$\therefore$,, ,, £$94\frac{1}{2}$,, £$3\frac{1}{2} \times \frac{86\frac{1}{2}}{91\frac{1}{2}}$
i.e., £$3\frac{9}{19}$.

But in the 2nd case an expense of £$94\frac{1}{2}$ yields £$4\frac{1}{2}$
$\therefore$ the railway stock is the better investment.

(*b*) $\left.\begin{matrix} 94\frac{1}{2} : 86\frac{2}{3} \\ 3\frac{1}{2} : 4\frac{2}{3} \end{matrix}\right\} :: £1050 : ?$

$$\frac{£1050 \times 86\frac{2}{3} \times 4\frac{2}{3}}{94\frac{1}{2} \times 3\frac{1}{2}} = \frac{£1050 \times 693 \times 9 \times 2 \times 2}{8 \times 2 \times 189 \times 7}$$

$$= \frac{£75 \times 33}{2} = \underline{£1237\ 10s.}\ \text{Ans.}$$

FEMALES.

1. Find the value of

(*a*) 15·625 ÷ 2·5
(*b*) ·015625 ÷ 25

(*a*) = 156·25 ÷ 25 = 6·25. Ans.

(*b*)
$$25 \left\{ \begin{matrix} 5 \mid \cdot 015625 \\ 5 \mid \cdot 003125 \\ \underline{\cdot 000625} \end{matrix} \right. \text{Ans.}$$

2. Show that $\frac{1·5}{·075} \times \frac{3·25}{1\frac{1}{2}} + \frac{1·875}{2·1} \times \frac{3·5}{3·75} = 44·16$

(*a*) $\frac{1·5}{·075} \times \frac{3·25}{1\frac{1}{2}} = \left(\frac{1\frac{1}{2} \times 3\frac{1}{4}}{\frac{3}{20} \times \frac{3}{2}}\right) = \frac{3 \times 13 \times 40 \times 2}{2 \times 4 \times 3 \times 3} = \frac{260}{6}$

(*b*) $\frac{1·875}{2·1} \times \frac{3·5}{3·75} = \frac{1\frac{7}{8}}{2\frac{1}{10}} \times \frac{3\frac{1}{2}}{3\frac{3}{4}} = \frac{15 \times 7 \times 10 \times 4}{8 \times 2 \times 21 \times 15} = \frac{5}{6}$

$\therefore \frac{260 + 5}{6} = \frac{265}{6} = \underline{44·16.}$ Ans.

3. What number must be subtracted from the product of 9·27 and 8·0003, to give the sum of 19, 27·9652, 5·0267, and 17·09?

(*a*)	(*b*)	
	19·	
	27·9652	
	·003	
9·27	5·0267	
8·0003	17·09	
74·162781	69·0849	= 5·077881. Ans.

4. Find the value of ·07 of £2 10s., and of ·7365 of 6s. 8d.

(*a*) ·07 of £2·5 = ·175 = 3·5s. = 3s. 6d. Ans.

(*b*) $\frac{1}{3}$ of £·7365 = ·2455 = 4·91s. = 4s. 10$\frac{32}{33}$d. Ans.

Grammar.

'Stern *daughter* of the voice of God,
O Duty! if *that* name thou *love*.
Who art a *light* to guide, a rod
To check the *erring* and *reprove*;
Thou who art *victory* and law
When empty terrors overawe.'—ODE TO DUTY.

(*a*) Give the meaning of the above passage in your own words.
(*b*) Parse the words in italics.
(*c*) Distinguish between an adjective sentence and an adverbial sentence, and give examples of both from the above.

(*a*) The voice of Duty may be called the voice of God. At one time she shows clearly the path of conduct in which we are to go, at another she punishes us for straying, and chides our waywardness. She enables us at all times to distinguish our real difficulties, and the extent of our obligations.

(*b*) *daughter*—com. noun, fem., sing., nom. of address or vocative.
that—demonstr. adj., limiting *name*.
love—reg. trans. verb, subjunctive, pres. indef., 2nd pers. sing., agr. with *thou*.
Who—simple rel. pron., referring to '*thou*,' 2nd pers., sing., nom., to *art*.
art—irreg. subst. verb, *am, was, been*, indic., pres., indef., 2nd pers., sing., agr. with *who*.
light—com. noun (here abstr.), neut., sing., nom., after *art*.
erring—adj. used as coll. noun, com., plur. obj., gov. by *check*.
reprove—reg. trans. verb, infin., pres., indef., attrib. to *rod*.
thou—pers. pron., referring to *Duty*, 2nd pers. fem., sing., nom. of address or vocative.
victory—abstr. noun, neut., sing., nom. after *art*.
When—conj. adv., introducing subord. clause, and mod. *overawe*.

(*c*) An adjective sentence or clause qualifies a noun; as, '*who art a light to guide*,' which qualifies *Duty*.
An adverbial sentence or clause modifies a verb or predicate; as, '*When empty terrors overawe*,' which modifies '*art victory and law*.'

Geography.

1. Give notes of a lesson on 'The Mountains and Rivers of Hindostan,' and illustrate it by sketch-maps of the chief river-basins. Insert the lines of latitude and longitude, and explain how they are useful in drawing maps.

N.B.—Do *not* draw a full map of the whole country.

The Mountains and Rivers of Hindostan.

MOUNTAINS.—1. The *Himalaya* ('abode of snow') chain, separating the basin of the Ganges from the upper basin of the Brahmaputra; three loftiest peaks—Everest, 29,002 feet; Kunchinjunga, 27,815; and Dhawalagiri, 26,826 feet. 2. *Aravulli Mts.* form W. wall of plateau of Malwa, and separate the basins of the Ganges and Lower Indus; *Mt. Abu* is the highest summit. 3. Vindhya Hills form S. wall of plateau, and separate the Jumna from the Nerbudda. 4. The *Sautpura Hills* separate the basins of the Nerbudda and Tapti, and are continued E. by the *Mahades Hills*. 5. The Western Ghâts extend for 1000 mls. form the water-parting between the Arabian Sea and Bay of Bengal, and constitute the W. wall of the table-land of the Dakhan. Vast quantities of moisture are deposited on them, and they give rise to all the large rivers of Southern India. 6. The *Nilgiris* S. of Mysore (Maisûr) connect the W. with the E. Ghâts, and form the S. wall of the plateau of Maisûr. Dodabetta is the highest summit. 7. The *E. Ghâts* extend from the Nilgiris in a N.E. direction, and form the E. margin of the Dakhan.

RIVER BASINS INCLINED TO THE ARABIAN SEA.—1. The *Indus* rises in Thibet, penetrates the Himalaya, flows S. to Attock, where it is joined by the *Kabul*: about 400 mls. further down it receives as one stream the five rivers of the Punjaub, and flows by seven mouths into the sea. 2. The *Nerbudda*, from Goondwana, flows W. between the Vindhya and Sautpura Mts. into the G. of Cambay. 3. The *Tapti* flows W. into the G. of Cambay.

RIVER BASINS INCLINED TO THE BAY OF BENGAL.—The *Ganges* issues in a small stream from a mass of perpetual snow on the S. side of the Himalaya Mts., and enters the plains of Hindostan after passing Hurdwar, receives the Jumna at Allahabad, is again swelled by the addition of several large streams in its progress to Patna, where it is three miles broad. About 200 mls. from the sea it branches into a delta, the numerous arms of which form a maze of channels and creeks called the *Sunderbunds*. The western or *Hoogly* branch, which passes Calcutta, is the only navigable one. The eastern branch receives the *Brahmaputra* before it passes into the Bay of Bengal.

The other rivers are the *Kaveri, Punnair, Krishna, Godaveri*, and *Mahanadi*, all flowing eastwards.

Lines of latitude and longitude are useful in giving places the exact relative position which they have on the earth itself, and they form a complete set of guiding lines for drawing a correct representation of any part of the earth.

2. If you were asked by children, 'What sort of a place is Africa?' how should you answer them, so as to give them an idea of the appearance and character of its different parts, and to show them how much more we know about it now than was known fifty years ago?

Africa is a vast table-land, or series of terraces, walled in by sea-coast ranges of mountains. South of the Mediterranean coast ranges lies the Great Desert, or Sahara, a great table-land rising in the middle to 4,000 feet above the sea. A wide tract in the west is said to be below the level of the sea, and it has been proposed to cut a canal from it to the Atlantic, and convert it into an inland sea. The surface of this desert consists of loose sand, gravel, and rocks. It is entirely without rivers. Here and there fertile spots, watered by springs, occur, at which caravans water their camels and rest after their toilsome, burning march across the desert. The sun beats down during summer, and the region is swept by hot winds, often carrying the stifling atmosphere to the shores of Europe. Travellers in the Sahara are often deceived by an appearance called the 'mirage,' presenting the appearance of a lake in which palm-trees are reflected (describe the disappointment of the weary

travellers). South of Sahara is Soudan, a broad, fertile country, containing the *Niger*, in exploring which *Mungo Park* lost his life. The interior is watered by *L. Tchad*. South of Soudan is *Central Africa*, crossed by the Equator, and, therefore, the hottest part of the earth. This used to be considered a barren desert, but a great part of it has within the last fifty years been crossed by travellers, who have found it a fertile and populous region. This region possesses the great lakes of Central Africa, and is drained by three of the great rivers of the world—the *Nile*, which fertilizes Egypt, and flows N.; the *Congo*, or *Livingstone*, flowing W.; and the *Zambesi*, flowing E. South of the Zambesi the country is very varied, being mountainous in the east, having a desert in the west, and bounded on the south by the Orange River. South of the Orange River is the most prosperous part of the African Continent. It consists of mountains, table-lands, and valleys, with abundance of pasture and cultivation. (*The three terraces of Cape Colony to be described.*) The '*Great Karoo*,' the highest of the three, is about a hundred miles broad. For nine months it is nearly bare, but during the other three it yields good pasture. The great travellers, Livingstone, Speke and Grant, Baker, Stanley, Cameron, and Burton, have cleared up the mysteries of Central Africa.

SECOND PAPER.

History.

Two hours and a half allowed.

1. Explain the terms Roundhead, Jacobite, Puritan, Regicide, and Chartists.

Roundhead was applied to those who supported the Parliament and wore their hair short, as opposed to the Royalists, who wore long hair, covering their shoulders.

Jacobite was applied to the partisans of James II., his son, and grandson. Derived from Lat. Jacobus—James.

The *Puritans* were seceders from the English Church, so-called on account of their acknowledging only the '*pure* Word of God,' without 'note or comment.' They were afterwards named *Nonconformists*.

The *Regicides* were those more closely connected with the trial and execution of Charles I.

The *Chartists* were those who, in 1838, promulgated the political system demanding the *People's Charter*, consisting of five principles—universal suffrage, annual parliaments, stipendiary members, vote by ballot, and electoral districts.

2. Give a short account of the trial of the Seven Bishops.

In 1688 William Sancroft, Archbishop of Canterbury, and six bishops of his province, signed a petition against the Second Declaration of Indulgence issued by James II. The King resolved to bring the petitioners before the Court of King's Bench on a charge of seditious libel. The 'Seven Bishops' were committed to the Tower amid marks of public sympathy. All Protestants regarded them as the champions of Protestantism against Rome. The main point at issue in the Bishops' trial was, as the Crown lawyers argued, 'a false, malicious, and seditious libel,' and this involved inquiry into the subject's right to petition for redress of grievances. The trial, at which not one of the judges ventured to say that the Declaration of Indulgences was legal, ended with a verdict of '*Not guilty*,' and at this result the delight of the nation knew no bounds.

3. Mention some of the most remarkable inventions of the nineteenth century, with names of the inventors.

Application of Steam-power to locomotives by *George Stephenson*.
Application of Electricity to convey intelligence by *Wheatstone and Cooke*.
Steam-printing-press (the Walter) by *Messrs. Macdonald and Calverly*.
Machines for working in iron by *Joseph Bramah*.
Steam-hammer and ram by *James Nasmyth*.
Rifled guns by *Joseph Whitworth*.
Sewing Machines by *Joseph Howe*.
Electric lighting by *Edison*.

Penmanship.

Write in large hand, as a specimen of copy-setting, the word *Pathetic*.

Write in small hand, as a specimen of copy-setting, *Englishmen know little of the French navy*.

Composition.

Write from memory the substance of the passage read out by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. All the interior angles of any rectilineal figure together with four right angles are equal to twice as many right angles as the figure has sides.

See Corollary to Euclid I. 32.

If the figure be equiangular and four interior angles be equal to seven right angles, find the number of sides.

Every angle $= 1\frac{1}{4}$ right angle
and let x denote the number of angles, which = also No. of sides
then $1\frac{1}{4}x+4$ right angles $= x$ sides $\times 2 =$
or $7x+16 = 8x$
i.e., $x = \underline{16}$ = No. of sides. Ans.

2. If a parallelogram and a triangle be upon the same base and between the same parallels the parallelogram shall be double of the triangle.

Euclid I. 41.

3. To describe a square upon a given straight line.

Euclid I. 46.

Algebra.

MALES.

1. Find the value of $x^3-3x^2y+3xy^2-y^3$, when $x=\frac{a+b}{2}$, $y=\frac{a-b}{2}$

since $x^3-3x^2y+3xy^2-y^3=(x-y)^3$
and since $x-y=\frac{(a+b)-(a-b)}{2}=b$
then the value of the expression $=\underline{b^3}$. Ans.

2. Find the G. C. M. of $91x^2y(x^3-3ax^2+2a^2x-2a^3)$, and $65xy^2(x^3+ax^2-a^2x+2a^3)$

(*a*) $91x^2y=(13xy)7x$, and $65xy^2=(13xy)5y$.
then $13xy$ = their G. C. M.

(*b*) As there is no common measure in the other factors $\underline{13xy}$ is the G. C. M. required.

3. Solve the equations—

(1) $\frac{1}{15}(3x+\frac{3}{5})-\frac{1}{3}(4x-6\frac{2}{3})-\frac{1}{2}(5x-6)=0$

(2) $\frac{6x+7}{9x+6}-\frac{5x-5}{12x+9}=\frac{1}{12}$

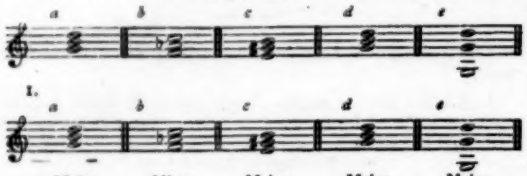
(1) Multiplying the equation by 14 we obtain
$3x+\frac{3}{5}-2(4x-6\frac{2}{3})-7(5x-6)=0$
clearing of fractions $9x+2-24x+40-105x+126=0$
changing sides and signs $-9x+24x+105x=126+20+2$
$120x=168$
$x=1\frac{2}{5}$

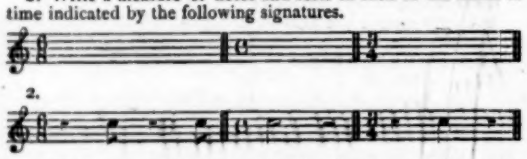
(2) Clearing of fractions—

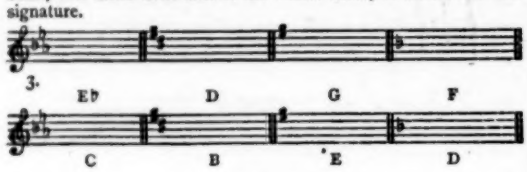
$72x^2+138x+63-45x^2+15x+30=\frac{1}{12}(108x^2+153x+54)$
$27x^2+153x+93=\frac{1}{12}(108x^2+153x+54)$
$324x^2+1836x+1116=108x^2+153x+54$
$324x^2-108x^2+1836x-153x=54-1116$
$216x^2+1683x=-1062$
$24x^2+187x=-118$
$x^2+\frac{187}{24}x=-\frac{118}{24}$
$x^2+\frac{187}{24}+(\frac{187}{48})^2=\frac{34969-11328}{2304}=\frac{23641}{2304}$
$x+\frac{187}{48}=\pm\frac{153\cdot75\ldots}{48}$
$x=\pm\frac{153\cdot75\ldots-187}{48}$
$\therefore\ x=-\frac{33\cdot25}{48}$ or $-\frac{340\cdot75}{48}$
$=-\underline{\cdot6927}$ or $-\underline{7\cdot098}$ Ans.

Music.

A quarter of an hour allowed for this Paper.

1. Which of the following chords are major and which minor?

2. Write a measure of notes and rests in each of the kinds of time indicated by the following signatures.



3. Write over each of the following the name of the major scale, and under each that of the minor scale, of which it is the signature.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May,* 1878; **and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

Arithmetic.

MALES.

1. A broker, whose commission is $\frac{1}{4}$ per cent., receives £4064 14s. 7½d. to invest in bank stock at 188¾; what amount of stock can he buy?

£100 is got for $188\frac{3}{4}+\frac{1}{4}$, or £188¾
£1 " " $\frac{400}{755}$
∴ £4064 14s. 7½d. " " $\frac{£4064\ 14s.\ 7\frac{1}{2}d. \times 400}{755}$
i.e. $\frac{£1625892\ 10s.}{755} = \underline{£2153\ 10s.}$ Ans.

2. I speculate and lose 10 per cent. of my capital; I then speculate with the remainder, and lose 20 per cent. of that. How much per cent. must I gain by a third speculation, on the sum still remaining, in order to be as well off as when I started?

Say the capital was £100.
∴ After 1st speculation he has £90 left,
and " 2nd " " ⅘ of £90, or £72.
Therefore to be as well off as at first the £72 must gain £18,
i.e. ¼ of itself, or 25 per cent. Ans.

3. A person invests in the 3 per cents. so as to receive 3 per cent. clear on his investment when the income tax is 9d. in the £. What per centage will he receive if the income tax be increased to 1s. in the £?

When he has 231 parts clear out of the £ he has 3 per cent. What percentage will he have when he has 228 parts clear?

231 : 228 :: £3 : ?
$£\frac{3\times228}{231} = £\frac{228}{77} = \underline{£2\ 19s.\ 2\frac{3}{7}d.}$ Ans.

4. Explain the difference between true and mercantile discount.

A debt is paid June 23, by a bill dated at six months; supposing the bill to be discounted October 14, the real discount would be £3 10s. Find the amount of the bill, the rate of discount being 5 per cent.

The Bill is due Dec. 26, reckoning the days of grace; and therefore it has 73 days to run after Oct. 14.
Discount on £100 for 73 days at 5 per cent. = £1.
∴ £1 : £3½ :: £101 : ?
£101 × 3½ = £353 10s. Ans.

5. Simplify— $\frac{2\times\sqrt{(1+\frac{1}{3})} \div \sqrt{1-\frac{1}{3}}}{5\times\sqrt{(1+\frac{1}{3})} \times \sqrt{(1-\frac{1}{3})}}$

Otherwise $\frac{\sqrt{(4\times\frac{1}{3})} \div \frac{1}{3}}{\sqrt{(25\times\frac{1}{3})} \times \frac{1}{3}} =$

$\sqrt{\frac{16\times5}{3\times4}} \div \sqrt{\frac{100\times4}{3\times5}} =$

$\sqrt{\frac{16\times5\times3\times5}{3\times4\times100\times4}} =$

$\sqrt{\frac{1}{4}} = \underline{\frac{1}{2}}$. Ans.

6. Find the compound interest on £100 for 5 years at 5 per cent.; and apply your result to find the amount of £8640 in the same time.

Interest of £1 for a year at 5 per cent. = £·05
Amount of " " = £1·05
£100 × $(1{\cdot}05)^5$ = £127·62815625 amount of £100
∴ £100 : £8640 :: £127·62815625 : amount required.
$£\frac{127{\cdot}62815625 \times 8640}{100} = £11027{\cdot}0727 =$
£11027 1s. $5\frac{1}{3}\frac{0}{1}\frac{7}{5}d.$ Ans.

FEMALES.

1. At what rate per cent. will £142 10s. amount to £163 13s. 11¼d. in 4½ years?

Interest for 4½ years = £163 13s. 11¼d. − £142 10s.
= £21 3s. 11¼d.
∴ £142 10s. : 100 } :: £21 3s. 11¼d. : ?
4½ yrs. : 1 yr. }
$\frac{£21\ 3s.\ 11\frac{1}{4}d. \times 100 \times 4}{142\frac{1}{2}\times17} = \frac{£84\ 15s.\ 9d. \times 200}{285\times17}$
$= £\frac{16957\frac{1}{2}}{4845}$
$= £\frac{3\,3\,9\,1\,5}{9\,6\,9\,0}$
$= \underline{3\frac{1}{2}}$ p.c. Ans.

2. A and B own a farm together; A owns $\frac{7}{12}$ of it, and B the remainder, and the difference between their shares is 17 ac. 0 ro. 20 po. Find the value of the farm if ⅔ of it be worth £50 an acre, and the rest of it £46 an acre.

Farm = 17 ac. 0 ro. 20 pr ÷ $(\frac{7}{12}-\frac{5}{12})$ = 17 ac. 0 ro. 20 po. × ½
= 102 ac. 3 ro.

	£	s.	d.
∴ ⅔ of 102¾ ac. at £50 per ac. = £50 × $\frac{3\times411}{32}$ = £50 × $1\frac{3}{4}\frac{8}{3}$ =	1,926	11	3
⅝ of 102¾ ac. at £46 per ac. = £50 × $\frac{5\times411}{32}$ = £50 × $2\frac{0}{3}\frac{5}{2}$ =	2,954	1	3
Total value of farm =	£4,880	12	6

3. If 4 p.c. be lost by selling linen at 2s. 9d. a yard, at what price must it be sold to gain 10 per cent.?

96 : 110 :: 2s. 9d. : ?
$\frac{33d.\times110}{96} = \frac{605d.}{16} = \underline{3s.\ 1\frac{1}{4}d.}$ Ans.

4. If A can do a piece of work in 10 days, and A and B can do it together in 7 days, in what time would B alone do it?

A does $\frac{1}{10}$ in 1 day; or $\frac{7}{70}$
A and B do $\frac{1}{7}$ " " ; " $\frac{10}{70}$
∴ B does $\frac{3}{70}$ in 1 day
or the whole in $\frac{70}{3} = \underline{23\frac{1}{3}}$ days. Ans.

Grammar.

1. "The vile strength man wields
For earth's destruction, thou dost all despise,
Hurling him from thy bosom to the skies."
Byron's Address to the Ocean.

(*a*) Point out the enlargement of the subject in the above, and give examples of the various ways in which the subject may be enlarged.

(*b*) Distinguish between enlargement and extension; and write out four sentences; two as examples of enlargements, two as examples of extensions.

(*a*) The enlargement of the subject is '*Hurling him from thy bosom to the skies*' enlarged by a participal phrase.

Other enlargements are:—

1. One or more adjectives:—*This old, red* book is mine.
2. Words in Apposition:—Garfield, *the President*, was assassinated.
4. A prepositional (adjective) phrase:—The fear *of man* is a snare.
5. A noun or pronoun in the possessive case:—*Harry's* uncle has come.
6. The gerundial infinitive:—Bread *to eat* was scarcely to be got.

(*b*) When we attach to a noun or pronoun an adjective, or a word or phrase equivalent to an adjective, by which we indicate more precisely that for which the noun or pronoun stands, this word or phrase is called an *enlargement:* as:—

1. William *of Normandy* was a man *of great ambition.*
2. Sentences *requiring little thought* can be written at once.

Any word or phrase which modifies or defines more clearly, the meaning of the predicate is called an *extension*, as:—

1. I stood (*a*) *in Venice* (*b*) *on the Bridge of Sighs.*
2. *So* sinks the day-star *in his ocean-bed.*

2. Parse each word in the following:—

I cannot help wondering at what you could see in my face, to think me a proper mark for deception.

PARSING.

I— pers. pron., 1st per. com., sing., nom. to *cannot.*
cannot—irreg. defec. verb. *can, could,* neg. form. indic. pres. indef. agreeing with *I.*
help—reg. trans. verb. infin. pres. indef. gov. by *can.*
wondering at—gerund (verbal noun) obj. gov. by *help*, and governing by its verbal force *what you could see in my face.*
what—rel. pron. (antecedent suppressed) neut. 3rd pers. sing., obj. gov. by *see.*
You—pers. pron. 2nd pers., com. plur. nom. to *could.*
could—irreg. defec. verb. *can, could,* indic. past indef. 2nd pers. plur. agr. with *you.*
see—irreg. trans., verb, *see, saw, seen,* infin. pres. indef. gov. by *could.*
in—prep. gov. obj. case *face.*
my—pronom. pos. adj. limiting *face.*
face—com. noun, neut., sing., obj., gov. by *in.*
to think—irreg. trans. verb, *think, thought, thought,* inf. pres. indef. gov. by some phrase like '*which caused.*'
me—pers. pron. 1st pers. sing., com, obj. gov. by *think.*
a—indef. art. (or adj.) joined to mark.
proper—adj. qual. *mark.*
mark—com. noun, neut. sing. obj. in apposition with *me.*
for—prep. gov. obj. case *deception.*
deception—abstr. noun, neut., sing. obj. gov. by *for.*

3. What are suffixes? Give examples of some which are of Teutonic (or German) origin, and of some which are of Latin origin, pointing out what each denotes.

Suffixes are syllables added to the end of a word root to modify its meaning, as:—

SUFFIXES OF TEUTONIC ORIGIN.

1. *—er* or—*ar*,—meaning a *person* or *doer*,—*singer, baker, beggar, liar.*
2. *—el*,—*le,* meaning *instrument*,—*shovel, girdle, shuttle.*
3. *—en—kin,* meaning diminutive,—*kitten, lambkin, pipkin.*

SUFFIXES OF LATIN ORIGIN.

1. *—tor—sor—or,* meaning *doers* or *agents*;—*doctor, successor, emperor.*
2. *—ble—cle,—cre,* meaning *instrument* or *place of some action*; —*stable, obstacle, lucre.*
3. *—al—an—ary* forming adjectives; *legal, pagan, necessary.*

Geography.

Answer two Questions.

1. Give notes of a lesson on '*Deltas*,' showing what they are, why they are so called, and how they are formed. Give as many examples as you can, and draw little sketch maps in illustration.

DEFINITION.—The term 'Delta' is applied more especially to that part of Lower Egypt which being comprised between the two main branches of the Nile and the sea had a triangular form somewhat resembling the Greek letter Δ. The same name is now generally given to all river-mouths of similar form. (*Draw sketch on blackboard and compare shape to a fan.*)

HOW FORMED.—When the river courses through a soft or sandy country it brings down mud in the water. As long as this water is running fast the mud is carried along; but when it meets the sea and comes to rest at its mouth, the mud falls down and forms a bed or bank between the river and the sea.

If there is a tide at the mouth of the river it will wash away the mud as fast as it is thrown down and prevent the delta from forming. Therefore the principal deltas occur in seas where there is little or no tide, as in the Mediterranean, Caspian, Gulf of Mexico.

EXAMPLES OF DELTAS.—Mouth of Nile, '*The* Delta'; mouths of the Po, the Ebro, in the Mediterranean; of the Volga, in the Caspian; of the Mississippi, in the Gulf of Mexico; Holland is a large delta of very ancient date formed at the mouths of the Rhine and Meuse; Holland and Lower Egypt are good examples of the way in which land is made out of the sea by the agency of a river; in India, the delta of the Ganges is called the Sunderbunds.

2. A traveller speaks of having seen the sun at midnight. Where must he have been? And how was it that he could see such a sight?

To have seen the sun at midnight the traveller must have been well up in Norway or Sweden, say at Hammerfest, where the sun never sets for two months in summer. In fact, these high latitudes must be enjoying their long day at this very season. This strange phenomenon may be explained as follows:—In the annual motion of the earth round the sun, and while turning on its axis, it passes through the varieties of day and night, summer and winter, which we enjoy. This variety of season is caused by the parallelism of the earth's axis, that is, by the pole or end of the axis pointing always to the same point among the fixed stars. So that when the sun is exactly over the equator at midday, day and night are equal over the whole globe, as it proceeds north or south in tracing out that imaginary track the ecliptic, he either lengthens or shortens the day. If he comes north, as he is doing at this season, our day continues to lengthen till about the 21st of June, which may be called the middle of the long Arctic day. The North Pole and a considerable portion of the earth's surface in its neighbourhood are situated within the enlightened half, therefore, at this point of the earth's wanderings it is continual day at the North Pole, and in all that region of the earth which encircles this pole, or within the *Arctic Circle.* On the other hand, the opposite or South Pole, with all the region comprised within the *Antarctic Circle* is in total darkness.

3. If a canal is ever cut between the Atlantic and the Pacific Oceans, through what part of America will it run? What sort of country will it have to be cut through? What will be the use of it? And what countries will find it convenient for their trade?

If a canal is ever cut between the Atlantic and the Pacific, it will be cut through the Isthmus of Panama, which has been repeatedly surveyed with the object of finding a route for a canal to connect the two oceans.

The average breadth of the isthmus is forty miles, but in one part it is narrowed to less than thirty miles. The surface is undulating, and the hills which extend through the isthmus are not more than 270 feet above the level of the Pacific. The soil is very fertile, and a great quantity of rain falls. The country is very rich in vegetable productions, and among the minerals are gold, copper, iron, and tin. The isthmus has some good harbours. There is a railway across it from Colon on the Atlantic to Panama on the Pacific. Starting from Aspinwall, in an un-

healthy marsh, the railway passes first through marshy ground, then through a dense tropical forest and the highest ground of the isthmus, after which it descends rapidly to the town of Panama.

The importance of a canal to the trade between European commercial countries, such as Britain, France, Germany, Italy, and the ports on the Pacific coast, and in as great a degree to the United States, is apparent from the great increase in the trade of these ports since the working of the railroad commenced. The route from Britain to her Australian colonies by Panama would almost lie in a straight line, and save at least 2,000 miles. The long and dangerous voyage round Cape Horn would also be saved.

SECOND PAPER.

Two hours and a half allowed.

History.

1. Explain the terms Bretwalda, Witanagemot, Crusader, Cavalier, and Balance of Power.

A *Bretwalda* was the chief of the kings of the Heptarchy, who exercised a certain undefined power over the other rulers.

Witanagemot was the great assembly of ecclesiastical and secular lords, etc., which formed the council of state under our Saxon kings, and was the germ of our present Parliament.

A *Crusader* was one who fought in the Holy wars, and wore a *cross*, fighting nominally at least, for the honour of the cross. Each nation had its special colour, that for England being *white*. Richard *Lionheart* led the third Crusade.

A *Cavalier* was an adherent of Charles I., and wore his hair hanging over his shoulders. Those of the opposing party wore short hair and were called *Roundheads*.

Balance of Power means the States of Europe so balanced that no one nation shall have such a preponderance as to endanger the independence of another.

2. Give dates of the following events:—Conquest of Ireland, Pilgrimage of Grace, Battle of Agincourt, American Independence. Write a short account of one of them.

Conquest of Ireland (1171).—Dermot, of Leinster, the king or chieftain of one of the several Irish States, being expelled from the throne, came to England asking assistance; and having done homage to Henry II., returned to Ireland with English knights and archers. He was followed by 'Strongbow,' Earl of Pembroke. These easily defeated the ill-armed Irish, and took possession of a number of towns and strong places. Henry himself landed in Dublin (1171), and received the homage of many native princes.

Pilgrimage of Grace (1536).—When Henry VIII., assisted by Cromwell, his vicegerent in church affairs, brought about the dissolution of the smaller monasteries, and appropriated their revenues; the North-country people, who clung to the old ways, broke out in revolt. The Yorkshire rebellion, led by one Robert Aske, was called, '*The Pilgrimage of Grace*.'

Battle of Agincourt (1415).—At Agincourt, not far from Crêcy, Henry V. met a French Army four or five times as numerous as his own. A great battle followed, in which the French were thrown into confusion by the skill and rapidity of the English archery. The French commander, and many thousands of his knights fell, and Henry returned home making a triumphant entry into London with his prisoners.

American Independence (1783).—Mr. Grenville, prime minister in the reign of George III., having declared that Americans ought to pay part of the British taxes, ordered their newspapers to be 'stamped,' like those in England. Upon this, the Americans refused to hold any commerce with Britain, and threw a cargo of taxed tea into the sea at Boston. Lord North now become premier, thereupon declared war against America, which lasted for eight years (1775-1783). The first battle was fought at Bunker's Hill. The principal British generals were Howe, Burgoyne, Clinton, and Lord Cornwallis; and the principal American commander was George Washington. Mr. Fox having succeeded to the premiership, formed a Whig ministry, which declared America independent (1783).

3. Mention the most celebrated writers of prose and poetry during the eighteenth and nineteenth centuries, with the titles of their best-known works.

PROSE.

Joseph Addison	...	'Tatler' and 'Spectator.'
Jonathan Swift	...	'Gulliver's Travels.'
Daniel Defoe	...	'Robinson Crusoe.'
Henry Fielding	...	'Tom Jones.'
David Hume	...	'History of England.'
Dr. Samuel Johnson	...	'Lives of the Poets.'
Dr. Wm. Robertson	...	'History of Scotland.'
Adam Smith	...	'Wealth of Nations.'
Oliver Goldsmith	...	'Vicar of Wakefield.'
Robert Southey	...	'Life of Nelson.'
Sir Walter Scott	...	'Waverley Novels.'
Thomas Carlyle	...	'French Revolution.'
Lord Macaulay	...	'History of England.'
Charles Dickens	...	'Pickwick Papers.'
W. M. Thackeray	...	'Vanity Fair.'
John Ruskin	...	'Modern Painters.'

POETRY.

Alexander Pope	...	'The Iliad,' 'Essay on Man.
James Thomson	...	'The Seasons.'
Oliver Goldsmith	...	'Deserted Village.'
Robert Burns	...	'Tam O'Shanter.'
William Cowper	...	'John Gilpin.'
Samuel T. Coleridge	...	'Ancient Mariner.'
William Wordsworth	...	'The Excursion.'
Robert Southey	...	'Wat Tyler.'
Lord Byron	...	'Childe Harold.'
Sir Walter Scott	...	'The Lady of the Lake.'
Thomas Campbell	...	'Pleasures of Hope.'
Thomas Moore	...	'Irish Melodies.'
Lord Macaulay	...	'Lays of Ancient Rome.'
Alfred Tennyson	..	'In Memoriam.'
Robert Browning	...	'Dramatic Lyrics.'

Penmanship.

Write in large hand, as a specimen of copy-setting, the word *Pathetic*.

Write in small hand, as a specimen of copy-setting, *Englishmen know little of the French navy*.

Composition.

Write a short essay on *the Watering-places of England*.

The watering-places of England may be comprised under three heads—namely, 'spas,' 'sea-side resorts,' and 'those which combine the characters of both spa and sea-side.'

The word 'spa' is derived from a town of that name in Belgium, noted for its medicinal springs. Some of the English spas have wells of water impregnated with *saline* ingredients, such as Epsom (from which we have Epsom salts), Clifton, Bath, Leamington, Matlock, and Buxton. Others, again, are impregnated with iron, and called *chalybeate* springs, the taste of these waters being of an inky character, and decidedly nauseous; such are the wells of Tunbridge, Brighton, Great Malvern, and Harrogate (from which we have Harrogate salts).

Many visitors reside at these places, where huge palatial hydropathic establishments have been erected for the convenience of patients; but many people frequent them not for drinking the waters, but merely as a relaxation, and for the enjoyment of the society always to be found there. Certain wells are recommended for certain diseases; and though the waters can be bottled and sent to all parts of the world, yet there can be no doubt that, in addition to all the advantages to be derived from change of scene, etc., it is better to drink them as they issue from the springs.

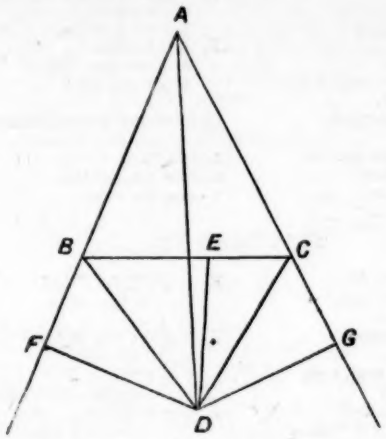
The 'sea-side resorts' of England are numerous on all her coasts, but more especially may be noted those on the south, where climate and natural position render them both beneficial and attractive. The very names of Torquay, Hastings, Isle of Wight, Brighton, Ramsgate, Scarborough, and Herne Bay bring longing to the invalid, and visions of holiday and delicious rest to those who require merely to recruit their jaded energies.

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. If two exterior angles of a triangle be bisected, the line

drawn from the point of intersection of the bisecting lines to the opposite angle of the triangle will bisect that angle.



Let the sides AB, AC of any triangle ABC be produced, the exterior angles bisected by two lines which meet in D, and let AD be joined, then AD bisects the angle BAC.

For draw DE perpendicular on BC, also DF, DG, perps. on AB, AC produced if necessary.

Then because in the triangles BDF, BDE, BD is common to the two, and angles at E and F are equal, as also the angles at B, then (by I. 26) the triangles are equal in every respect, and ∴ DF = DE.

In the same manner DG = DE.

Wherefore DF = DG, being equal to the same thing.

Again, the sq. on DA = sqs. on DF, FA or sqs. on DG, GA that is the sqs. on DF, FA = the sqs. on DG, GA, of which the sq. on DF is equal to the square on DG; hence AF = AG.

Now since the side FA = the side AG and AD is common to the two triangles ADF, ADG, and since the base DF is equal to the base DG, then (I. 8) the angle FAD = the angle DAG, that is BAC is bisected by the straight line DA. 2 E. D.

2. If a straight line be divided into any two parts, the square on the whole line is equal to the squares on the two parts, together with twice the rectangle contained by the parts.

Euclid II., 4.

3. To divide a given straight line into two parts, so that the rectangle contained by the whole, and one of the parts, shall be equal to the square on the other part.

Euclid II., 11.

Algebra.

1. Prove that $(5a+4b+3c)^2-(3a+4b+5c)^2=16\,(a-c)\,(a+b+c)$

(*a*) $(5a+4b+3c)^2 = 25a^2+16b^2+9c^2+40ab+30ac+24bc.$

(*b*) $(3a+4b+5c)^2 = 9a^2+16b^2+25c^2+24ab+30ac+40bc.$

∴ Subtracting (*b*) from (*a*) $16a^2 - 16c^2 + 16ab - 16bc. =$
$16(a^2-c^2+ab-bc)=$
$16\,(a^2+ab+ac-ac-bc-c^2)=$
$16\{a\,(a+b+c)-c\,(a+b+c)=$
$16\,(a-c)\,(a+b+c)$ 2. E. D.

2. Simplify $\frac{2\,(2a-b)}{9a^2-4b^2}+\frac{1}{3a-2b}$, and $\frac{1}{3a+2b}+\frac{2\,(2a+b)}{9a^2-4b^2}$; and divide the one result by the other.

(*a*)

$$\frac{2\,(2a-b)}{9a^2-4b^2}=\frac{4a-2b}{9a^2-4b^2}$$

$$\text{and } \frac{1}{3a-2b}=\frac{3a+2b}{9a^2-4b^2}$$

By addition we get $\frac{7a}{9a^2-4b^2}$ for 1st result.

(*b*)

$$\frac{1}{3a-2b}=\frac{3a-2b}{9a^2-4b^2}$$

$$\text{and } \frac{2\,(2a+b)}{9a^2-4b^2}=\frac{4a+2b}{9a^2-4b^2}$$

By addition we get $\frac{7a}{9a^2-4b^2}$ for 2nd result.

$$\therefore \frac{7a}{9a^2-4b^2}\div\frac{7a}{9a^2-4b^2}=\frac{7a\,(9a^2-4b^2)}{(9a^2-4b^2)7a}=1.\ \text{Ans.}$$

3. Solve the equations :—

$$(1)\ \begin{cases} 125x-124y=24{\cdot}9 \\ 9y-8\tfrac{1}{2}x=1{\cdot}6 \end{cases}$$

$$(2)\ 35x^2-3x=494$$

(1) $125x-124y=24{\cdot}9$

$9y-8\frac{1}{2}x=1{\cdot}6$ or $45y-44x=8$

$$y=\frac{8+44x}{45}$$

Substituting for y in 1st equation

$$125x-124\left(\frac{8+44x}{45}\right)=24{\cdot}9$$

$$5625x-992-5456x=1120{\cdot}5$$

$$169x=2112{\cdot}5$$

$x=12\frac{1}{2}$ Ans.

Hence $y=12\frac{1}{2}$ Ans.

(2) $35x^2-3x=494$

$x^2-\frac{3}{35}x+(\frac{3}{70})^2=\frac{4\,94}{1}+\frac{9}{4900}$

$x^2-\frac{3}{35}x+\frac{9}{4900}=\frac{69160+9}{4900}=\frac{69169}{4900}$

$x-\frac{3}{70}=\pm\frac{263}{70}$

$x=\frac{3}{70}\pm\frac{263}{70}=3\frac{1}{2}$ or $-3\frac{7}{10}$ Ans.

Mensuration.

MALES.

Answer *one* Question.

1. A rectangular field is 440 yds. long, and 154 yds. wide; find its area in acres. Also find the areas of the portions into which it is divided by a straight line drawn from the middle point of one side to one of the opposite corners.

Area = 440 yds. × 154 = 67760 sq. yds. = $\frac{67760}{4840}$ ac. = 14 ac. Ans.

Now since the line drawn from the middle of one side to the opposite corner cuts off one-fourth on one side and three-fourths on the other—

then $\frac{1}{4}$ of 14 ac. = $3\frac{1}{2}$ ac. and $\frac{3}{4}$ of 14 ac. = $10\frac{1}{2}$ ac.

2. From a square is cut out the inscribed circle; what fraction of the square is left?

Since it has been found by experiment that the area of a square, whose side is unity, is greater than the area of the inscribed circles by the difference between unity and ·7854

∴ the remainder = 1 − ·7854 = ·2146 =
$\frac{2146}{10000}=\frac{1073}{5000}$ of the square. Ans.

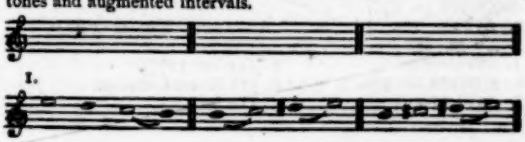
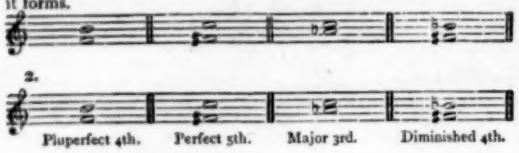
Needlework.

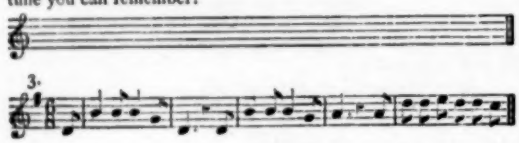
FEMALES.

One hour allowed for this Exercise.

Music.

A quarter of an hour allowed for this Paper.

1. Write the upper tetrachord of E (*Mi*) minor in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.

2. Write under each of the following pairs of notes the name and quality (major, perfect, diminished, or other) of the interval it forms.

3. Write, from memory, the first four or more measures of any tune you can remember.



ANSWERS TO ALGEBRA QUESTIONS IN 'THE SCHOLAR,' FOR JULY, 1882.

EXERCISE VIII.

(1) $x-y$, $x-a-b$. (2) $8a^2bc$. (3) $3a+2b-3c$. (4) $48xyz$. (5) $6a-3b+8c+1$. (6) $3x^3-9x^2+10x-14$. (7) $x+y+z-a-b-c$. (8) $a+c$. (9) $-b+c$. (10) $(x+y)-(x-y)$.

ANSWERS TO ARITHMETICAL QUESTIONS IN 'THE SCHOLAR,' FOR JULY, 1882.

STANDARD III.

A. 1. 41,212—7.
2. 26,817—20.
3. 2,993,088—40.
B. 1. 93,964—417.
2. 889—18386.
3. 67—4908.
C. 1. £199 16s. 7¼d.
2. £714 13s. 9½d.
3. £162,455 2s. 9½d.
D. 1. 652,546 farthings.
2. 34,212 apples.
3. 7,608.
E. 1. 651 slates.
2. £466 13s. 4d.
3. 582—41,963.
F. 1. £9,462 11s. 6½d.
2. 14,498,894.
3. 77—897,170.

ADVANCED EXAMINATION.

1. 6989,378,011 farthings.
2. 252 tons.
3. £300.

STANDARD IV.

A. 1. £19,218 7s. 2½d.
2. £60,980 5s. 2½d.
3. £264 19s. 10½d.—18.
B. 1. £44,719 6s. 9½d.
2. 1,021,440 oz.
3. £26 14s. 1½d.—41.
C. 1. 2279 t. 14 c. 3 qr. 24 lb. 7 oz.
2. £259 8s. 6½d.
3. 1s. 6½d.—467,920.
D. 1. 2s. 2½d.
2. 506,108,100 sec.
3. 322 shirts, and 2 yd. 3qr. 2 nl. left.
E. 1. £67 19s.
2. £661,245 18s. 9d.
3. £151 5s.
F. 1. £81 14s. 8⅔d.—2505.
2. 5,487 lb. 4oz. 15 dwt. 8 gr.
3. 301 ton. 12 cwt. 2 qr. 9 lb.

ADVANCED EXAMINATION.

1. 42½ min. past 7.
2. £60 19s. 6d. gain.
3. 8 ton. 9 cwt. 21 lb. 12 oz. 9 dr.—4663.

STANDARD V.

A. 1. £81 17s. 3½d.
2. £180 11s. 2½d.
3. £357 17s. 9½d.
B. 1. £346 14s. 7½d.
2. £7,550 3s. 1½d.
3. £5 6s. 9½d.
C. 1. £6,988 5s. 6½d.
2. £72,211 17s. 2½d.
3. £6 3s. 8½d.
D. 1. 220 horses.
2. £37,339 2s. 5½d.
3. £268 17s.
E. 1. £4577 15s. 8½d.
2. 169.
3. £63 15s. 9d.
F. 1. £117 12s. 7½d.
2. £135 8s. 4d.
3. £84 1s. 0½d.

ADVANCED EXAMINATION.

1. £61 0s. 11$\frac{3}{11}$$\frac{3}{11}$d.
2. 37½ lb. each cheese.
3. £61 4s.

STANDARD VI.

A. 1. 12$\frac{7}{12}$.
2. $\frac{5}{8}$.
3. ·03359375.
B. 1. $\frac{49}{50}$.
2. ·00502.
3. £2 19s. 10$\frac{1}{2}$$\frac{3}{4}$d.
C. 1. 11$\frac{1}{4}$$\frac{1}{8}$$\frac{1}{16}$.
2. £11 9s. 9$\frac{1}{12}$d.
3. 1$\frac{1}{11}$.
D. 1. £39 1s. 3d.
2. 7·7758+
3. $\frac{3}{5}$$\frac{3}{8}$.
E. 1. £20 11s. 8d.
2. ·000001875.
3. 8 hr. 6 mn.
F. 1. 5$\frac{5}{11}$ days.
2. £294 12s. 1$\frac{1}{2}$d.
3. £1 5s. 7$\frac{5}{12}$d.

ADVANCED EXAMINATION.

1. 112$\frac{6}{11}$$\frac{6}{11}$.
2. £28 1s. 6·1632.
3. £44 8s. 10$\frac{1}{2}$d.

STANDARD VII.

A. 1. £73 2s. 6d.
2. 4$\frac{1}{2}$$\frac{1}{6}$ per cent.
3. 3$\frac{3}{5}$ years.
B. 1. 7$\frac{1}{4}$ per cent.
2. £1010.
3. 1$\frac{3}{8}$ per cent. loss.
C. 1. £12675
2. 3$\frac{3}{4}$$\frac{1}{9}$ per cent.
3. £5025 12s. 6d.
D. 1. £28 16s. 6$\frac{4}{7}$d.
2. £1059 4s. 8$\frac{8}{15}$d.
3. 4$\frac{2}{3}$$\frac{5}{8}$ per cent.
E. 1. £185 6s. 8·49d.
2. £2 13s. 2$\frac{8}{9}$d.
3. £625.
F. 1. £743 17s. 8$\frac{1}{11}$d.
2. £8 12s. 6$\frac{3}{4}$d.
3. £2 17s. 0$\frac{6}{7}$d.

ADVANCED EXAMINATION.

1. 529296·768 pop., and 32·324192 per cent.
2. 84$\frac{1}{3}$ per cent.
3. 131$\frac{2}{167}$ days.

SOLUTIONS OF THE 'ADVANCED EXAMINATION' QUESTIONS IN 'THE SCHOLAR,' FOR JULY, 1882.

STANDARD III.

1.

£	s.	d.	
8,061,019	0	7½	
780.416	18	8½	
7,280 602	1	10½	= 6989 378,011 f. Ans.

2. ¾d. × 140 = 105d. cost of 1 ton.
£110 5s. = 26460d. which ÷ 105 = 252 tons. Ans.

3. (96 × 150 × 24) ÷ 6 = 57600 lb. of potatoes.
57600 lb. at 1¼d. = 72000d. = £300. Ans.

STANDARD IV.

1. From June 2 at 1.30 p.m. to June 26 at 7.30 p.m. is 24 days 6 hours, or 24¼ days; hence the gain is 24¼ *half* minutes = 12⅛ minutes, which added to 7·30 = 7·42½ p.m. Ans.

2. 2240 lb. − 12 lb. = 2228 lb. sold for every ton bought.
2228 × 5½ = 12254 lb. at 4¼d. = 55143d.
2228 × 4½ = 10026 lb. at 3½d. = 35091d.
= 90234d. = £375 19s. 6d., total selling price.
And £375 19s. 6d. − £315 (300g.) = £60 19s. 6d. gain. Ans.

3. ☞ To work out this exercise at length would occupy too much space. It is given as a test of sustained mechanical accuracy. See the Answer.

STANDARD V.

1. Bringing both the weights to lbs., we have 62146 lb. and 1756 lb.; and £1 14s. 6d. = 69s., then by simple proportion expressed fractionally, we have $\frac{69s. \times 62146}{2 \times 1756}$ = $\frac{4288074}{3512}$ = 1220s. 11$\frac{3}{11}$$\frac{3}{11}$d. = £61 0s. 11$\frac{3}{11}$$\frac{3}{11}$d. Ans.

	£	s.	d.	
2. £140 12s. 6d. ÷ 150	= 18	9		cost of each cheese.
1s. 3d. by 60	= 3	15	0	(*a*) gain by wholesale.
(21s. 0d. − 18s. 9d.) × 50	= 5	12	6	
£18 15s − £9 7s 6d. (*a*)	= 9	7	6	(*b*) „ retailing 40 ch.
18s. 9d. × 40	= 37	10	0	prime cost of „
Hence £9 7s. 6d. (*b*) + £37 10s.	= 46	17	6	selling price „
£46 17s 6d. ÷ 40	= 1	3	$5\frac{1}{2}$	„ „ 1 „
£1 3s. $5\frac{1}{2}$ ÷ $7\frac{1}{2}$d.	= $37\frac{1}{2}$ h. Ans.			

	£	s.	d.	
3. $\frac{3}{4}$ of £48 = 36, which at 3s. 6d. in the £	= 6	6	0	P. rate.
$\frac{1}{5}$ „ 40, „ 1s. 3d. „ „	= 2	10	0	G. „
$\frac{2}{3}$ „ 32, „ 2s. 9d. „ „	= 4	8	0	G.D. „
	Rent = 48	0	0	
	Ans. £61	4	0	

STANDARD VI.

1. $(\frac{3}{4}$ of $5\frac{2}{3}) = (\frac{3}{4}$ of $\frac{17}{3}) = \frac{51}{12} = 3\frac{3}{4}$.
$8\frac{5}{8} + 3\frac{3}{4} = 12\frac{1}{8}$ sum, $8\frac{5}{8} - 3\frac{3}{4} = 4\frac{7}{8}$ diff.; and
$(8\frac{5}{8} \times 3\frac{3}{4}) = (\frac{69}{8} \times \frac{15}{4}) = \frac{1035}{32} = 32\frac{11}{32}$ product.
$12\frac{1}{8} + 4\frac{7}{8} + 32\frac{11}{32} = 50\frac{15}{32} = 50\frac{1}{32}$ sum of the 3 results.
$(8\frac{5}{8} \div 3\frac{3}{4}) = (\frac{69}{8} \div \frac{15}{4}) = (\frac{69}{8} \times \frac{4}{15}) = \frac{23}{10}$ quotient.
$50\frac{1}{32} = \frac{1601}{32}$, and $\frac{1601}{32} \times \frac{23}{10} = \frac{36823}{320} = 112\frac{183}{320}$. Ans.

2. 4·85 c. ft. × 60 × 3·2 × 180 = 167616 c. ft. = 167·616 = *thousand* c. ft., which multiplied by 3·35 = 561·5136s. £28 1s. 6·1632d. Ans.

3.

	logs.	lngth.	brdth	dpth.	ratio
	£18 ×	80 ×	20 ×	16 ×	12 × 5 =
	30 ×	12 ×	18 ×	8 ×	12

(each pair of terms being expressed in simplest ratio)

$\frac{£18 \times 8 \times 8 \times 3 \times 5}{3 \times 3 \times 9 \times 2 \times 12}$ = (when cancelled) £$\frac{400}{9}$
= £44 8s. 10$\frac{2}{3}$d. Ans.

STANDARD VII.

10 p.c. is $\frac{1}{10}$	400000	
	40000	
8 „ „ $\frac{8}{100}$	440000	population in 1891
	35200	
5 „ „ $\frac{3}{60}$	475200	„ „ 1901
	23760	
4 „ „ $\frac{3}{125}$	498960	„ „ 1911
	19958·4	
2 „ „ $\frac{3}{600}$	518918·4	„ „ 1921
	10378·368	
Ans.	529296·768	„ „ 1931

Again,—129296·768 is the *increase* in the 50 years on 400000, that is on 4000 *hundreds*; hence 129296·768 ÷ 4000 = 32·324192 per cent. Ans.

2. 10 × 160 = 1600, 9 × 50 = 450, 8 × 20 = 160, 7 × 20 = 140, 6 × 15 = 90, 5 × 10 = 50, 4 × 5 = 20, 3 × 5 = 15, 2 × 3 = 6, and 0 × 12 (rem.) = 0. These ten numbers added together give a total of 2531 *actual* attendances out of a *possible* total of (10 × 300 =) 3000 attendances. Then 2531 ÷ 30 (the number of *hundreds* in 3000) = 84$\frac{11}{30}$ per cent. Ans.

3. £85 − £83 10s. = £1 10s. discount allowed. Working on the true principle of discount—*that the present worth if put out at interest would make what has been taken off for discount*—the question may be thus simply presented, and worked by proportion;—if £100 makes £5 interest in a year (365 days), in how many days would £83 10s. make £1 10s. interest? Bringing each of the terms of money to *half* sovereigns and cancelling we have:—

$$\frac{365\text{d.} \times 200 \times 3}{167 \times 10} = \frac{21900}{167} = 131\frac{23}{167} \text{ days. Ans.}$$

Gossip.

We gladly find a place for the following paragraph, which appeared in the *Schoolmaster* of June 17th:—

'Some five years ago a statement appeared in the columns of the *Schoolmaster* to the effect that Mr. Waugh was at that time "engaged, etc., etc." The paragraph has been recently quoted in an educational contemporary, but we now learn on the best authority that the statement was incorrect. In so far as it was in any way inaccurate we regret the appearance of the paragraph in question.'

***

Messrs. W. S. Sonnenschein and Co. announce for immediate issue a series of Code Readers, intended to meet the requirements of the new Mundella Code. They will contain original and selected passages, and short stories in prose and verse, and be fully illustrated with excellent engravings.

***

The same publishers have recently issued an edition of the Third Book (on Words) of Lock's 'Essay on the Human Understanding,' with an introduction and copious notes by Mr. F. Ryland, M.A., author of the 'Student's Manual of Psychology and Ethics.'

***

The Right Hon. John Bright, as Lord Rector of the University of Glasgow, has offered a prize of twenty-five guineas for the best essay on the 'Influence of the Italian Republics on the Civilization of Europe.' Students of the last three sessions will be entitled to compete.

***

Messrs. Cassell, Petter, Galpin and Co. announce a people's edition of the Leopold Shakspere, in ten six-penny monthly parts. This edition is too well-known to need description, but we would point out to those of our readers who are in want of a good cheap Shakspere, one or two of its distinctive features:—the admirable *Introduction* by Mr. F. J. Furnivall, and the advantage of having the plays arranged in chronological order. The 'Two Noble Kinsmen' and 'Edward III.' are included in the Leopold edition.

***

The Day of Rest, which was, some two or three years ago, a most admirable journal for Sunday reading, but whose pages have of late been greatly disfigured by coloured illustrations, has ceased to exist in separate form, and will henceforth be incorporated with the *Sunday Magazine*.

***

Mr. Alexander Gardner has in the press a volume of *Selections from Wordsworth*, edited by Mr. J. S. Fletcher, who has written an Introductory Memoir to the chosen poems.

***

One of the most interesting books for boys ever written has just been published by Messrs. Sampson, Low and Co. It is by Mr. Richard Jeffries, the well-known author of 'The Gamekeeper at Home,' 'Wood Magic,' and other works on country life, and is entitled 'Bevis, the Story of a Boy.' No better prize for a boy could be found.

***

By the time this issue of our journal reaches the hands of our readers, many of them will be arranging their summer 'outing.' Some will doubtless seek renewed vigour under the exhilarating influence of foreign travel; others will choose a favourite watering-place on the coast; and there may be a few who, unstrung with overwork, long for the quiet repose of the country. To these latter we think we can be of some little service. We have derived so much benefit from a short stay at the Bishop's Down Grove Spa, Tunbridge Wells, that it is with unusual pleasure we mention this charming health-resort to our friends. Situate on the summit of one of the breezy

Sussex downs, it commands exceptionally fine views of the surrounding country. The grounds—sixty acres in extent—are of almost unrivalled beauty, and are alone well worth a visit. Here also may be found all the usual appointments of a good hotel. No pains have been spared to provide both for the indoor and outdoor recreation of the visitors. Who that has travelled but a little, has not unpleasant recollections of the long tedious evenings spent in hotels, when the weather has been unpropitious? At the Spa, however, the evening's entertainment is often the most enjoyable. Adjoining the drawing-room there is a delightful bijou theatre, where occasionally operas, plays, concerts, charades, and lighter entertainments are presented to the guests. During our stay we witnessed an opera—'Don Pasquale,' by the Campobello-Sinico troupe—miscellaneous concerts, a reading, and a play. In the preparation of these entertainments some one must of necessity sacrifice a large share of their own pleasure for that of the company. This was cheerfully done by Mrs. Galsworthy and family, who won golden opinions from the visitors for their ready kindness in organizing several evenings' amusements. Perhaps the most enjoyable evening was that on which the laughable farce of '*Poor Pillicoddy*' was presented. This sketch was given after only two days' preparation. Here is the cast :—

Mr. Pillicoddy	Mr. Robert Hickie.
Captain O'Scuttle	Mr. Frank Galsworthy.
Mrs. Pillicoddy	Mrs. Galsworthy.
Mrs. O'Scuttle	Miss Jane Dealy.
Sarah	Miss Blanche Williams.

We must not forget to state that Miss Blanche Galsworthy ably presided at the pianoforte. These amateurs entered into their work *con amore*, and the result was a complete success, each character being much appreciated by the audience. The '*Sarah*' of Miss Blanche Williams was an admirable piece of acting. Her by-play—at once quiet, humorous, and effective—gave evidence not only of good natural ability, but of careful study. Dr. Partington, the genial physician of the establishment, appeared in a new *rôle*, that of the prompter. We offer one and all our hearty congratulations. Any friends wishing to know particulars of the 'Spa' as a health-resort can have them upon application to the secretary.

***

We hear that Miss Frost is now making arrangements to hold her examination in connection with another established Kindergarten Training College, from which certificates are issued in June, 1883. Students wishing to be prepared for this examination should enter the College, 83, Gloucester Road, South Kensington, W.

***

We have received an early copy of 'Plays and Dramatic Pieces,' by Martin Tupper. The book is handsomely bound, and forms an admirable volume for presentation. Of its merit we forbear to speak, as the author is on our staff. This is a rule, which, in the conduct of this journal, we have for some time past observed.

***

For the same reason we simply announce the publication of Mr. Joseph S. Fletcher's clearly printed and neatly bound 'Early Poems.'

***

We cut the following from our vigorous, outspoken contemporary, the *Figaro* :—

'Mr. Harry Wall could hardly have spent a very happy Sabbath. A British jury awarded him one shilling damages in two separate cases, and a British judge very justly ordered Mr. Wall to pay the costs of both sides. The last case, decided on Saturday, was one of those in which Mr. Wall has gained so unenviable a notoriety. A working-men's tea-party was given at Over Darwen, and the vicar took the chair. Eightpence was charged to non-members, and fourpence to members, for their tea. Some of the residents, and among them the schoolmaster, undertook to amuse the working-men after their temperate feast, and for this no charge was made. Among the songs was "Will-o'-the-wisp." Of course Mr. Harry Wall was down upon the schoolmaster for his miserable "penalties," and threatening letters were likewise sent to the vicar, who had been guilty of the terrible crime of listening to the song, and upon the accompanist. "Cherubino" was consulted, and on his advice the action was defended. Judge and jury marked their opinion of this wretched grabbing from the poor by casting Mr. Wall in costs. Amateurs who are threatened by Mr. Wall need, therefore, not be frightened.'

'Cherubino' is the able musical critic of the *Figaro*.

***

The lamented death of Mr. Thomas Dunman, who was so well known as a teacher of Physical Science at various institutions in London, was lately noticed in our columns. We are glad to learn that a fund is being collected for helping his widow and children The Committee includes several members of the Council of the Working Men's College, and Mr. R. B. Litchfield, Bursar of the College (4, Bryanston Street, Portman Square), is the treasurer.

—o—

Publications Received.

Arithmetic—
(1) Leedam's Systematic Mental Arithmetic. Philip and Son.
(2) Ellery's English Arithmetical Cards. W. and R. Chambers.
(3) Allen's Taunton Arithmetical Cards. W. and R. Chambers.
(4) Leedam's Systematic Elementary Arithmetic with Answers. Philip and Son.

Ethics—
(1) Bray's Elements of Morality. Longmans, Green, and Co.

Geography—
(1) Hughes's Elementary Class-book of Modern Geography. G. Philip and Son.

Geology—
(1) Clement's Tabular View of the Geological Systems. W. S. Sonnenschein and Co.

History—
(1) Home Lesson Books to Royal History Readers. Nelson and Sons.

Kindergarten Literature—
(1) Mulley's Songs and Games for Little Ones. W. S. Sonnenschein and Co.
(2) Lewis's Songs for Little Singers. Hodder and Stoughton.

Latin—
(1) Leonard's Latin Grammar. Thomas Murby.

Miscellaneous—
(1) Higginson's Common Sense about Women. W. S. Sonnenschein and Co.
(2) Bisson's Drama as an Element of Education. Simpkin, Marshall and Co.
(3) School Examination Register. Bemrose and Sons.
(4) A.B.C. Education Code. Nelson and Sons.
(5) Key to the New Code. National Society.
(6) The Sunbeam Library. Longmans and Co.
(7) Midland Analysis and Parsing Exercise Book. Midland Educational Co.
(8) Ryland's Locke on Words. W. S. Sonnenschein and Co.

Periodical Literature—
(1) Sports and Pastimes. No. 3. Cassell, Petter, Galpin, and Co.
(2) Universal Instructor. Part 20. Ward, Lock, and Co.

Prize Books—
(1) Doudney's Michaelmas Daisy. Griffith and Farran.

Readers—
(1) Chambers' Grad. Readers I. and II. W. and R. Chambers.

Science—
(1) Watts' Science in a Nutshell. W. and A. K. Johnston.
(2) Edmonds' Elementary Botany. Longmans, Green, and Co.

Scripture—
(1) Linton's Second Epistle to the Corinthians. G. Philip and Son.

Query Column.

☞ As the answer to a single question often entails an expense six or seven times greater than the cost of the complete key to any of the Arithmetics or Algebras ordinarily used, the Proprietor of this Journal would be glad if students confined themselves to questions, the full working of which is not published in the form of a 'key.'

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents who send numerical or algebraical questions for solution, and are able from any source to give the required answer, would do so. It would save much time at present spent on verification.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. Replies will not be sent through the post.

4. Correspondents are requested to write *legibly*, and on one side of the paper only.

5. Correspondents wishing us to recommend books for any (other than the ordinary Government) Examinations, or to answer any questions concerning that Examination, must, in all cases, send a copy of Regulations up to date.

6. Queries must reach the office *not later than the 15th of the month*, or they cannot be attended to in the following issue.

7. All queries in future must have a pseudonym, and must be written on a slip of paper other than that which bears the real name and address of the sender.

*** All communications for this column should be addressed

'*The Query Editor*,'
The Practical Teacher,
Pilgrim Street, Ludgate Hill,
London, E.C.

Arithmetic.

1. BEDE.—A tradesman's prices are 20 per cent. above cost price. If he allow a customer 12 per cent. on his bill, what profit does he make?

Suppose cost price were £100,
Then tradesman's price would be £120;
Selling price after deducting discount = £120 − 12 % on £120
= £120 − £14⅖
= £105⅗;
∴ Profit = 5⅗ per cent. Ans.

2. E. S., Newcastle.—At a game of billiards A can give B 15 points in 50, and he can give C 20 in 50; how many can B give C in a game of 70? (Barnard Smith.)

A can give B 15 points in 50,
" " C 20 " 50;
∴ B makes 35 points, while A makes 50,
C " 30 " " A " 50;
∴ B can give C 5 points in 35,
" " C 10 " 70. Ans.

3. EYES FRONT.—On what day of the week will the 1st of January fall in 1880, in 1890, and in 1900, respectively? (*Johnston's* 'Civil Service Arithmetic.')

1st January, 1880 was on Thursday.

In the 10 years from 1st January, 1880, to 1st January, 1890, there are 3 leap years;

∴ From 1st January, 1880, to 1st January, 1890, there are 520 weeks and 13 days, that is, 521 weeks and 6 days.

∴ 1st January, 1890, will fall on Wednesday.

In the 10 years from 1st January, 1890, to 1st January, 1900, there are 2 leap years;

∴ From 1st January, 1890, to 1st January, 1900, there are 520 weeks and 12 days, that is, 521 weeks and 5 days.

∴ 1st January, 1900, will fall on Monday.

NOTE.—Queries are *not* confined to Mathematical Questions.

4. CHIMBORAZO.—In what years of the present century are there five Saturdays in February? Give reasons for your answer.

5 Saturdays in February occur in the leap year when the first of the month falls on that day.

In 4 years there are 208 weeks and 5 days;

∴ 1st February in a leap year falls two days earlier than in the previous leap year;

∴ 1st February in a leap year will fall on the same day in 4 × 7 or 28 years.

1st February 1880 was on Sunday;
" 1884 will fall on Friday;
" 1888 " Wednesday;
" 1892 " Monday;
" 1896 " Saturday.
∴ The years are 1896, 1868, 1840, and 1812. Ans.

5. LATIN.—A person bought a French watch, bearing a duty of 25 per cent.; and sold it at a loss of 5 per cent.; had he sold it for £3 more, he would have cleared 1 per cent. on his bargain. What had the French maker for it? (*Barnard Smith.*)

Suppose the watch cost £100;
Then cost with duty = £125.
Loss = 5 per cent. on £125 = £6 5s.;
Gain of 1 per cent. = $\frac{1}{125}$ of £125 = £1 5s.;
Difference between the two prices = £6 5s. + £1 5s.
= £7⅓.

∴ Cost of watch = £100 × $\frac{3}{7\frac{1}{3}}$
= £100 × $\frac{3}{22}$
= £40. Ans.

6. YELSERP.—A person had £10,000 in the 3 per cent. South Sea Annuities, and the government offered to give £110 bearing interest at the rate of 2½ per cent. for every £100 of these annuities, or to pay the £10,000 in cash on a certain day. The latter proposal was preferred, and on the money being paid it was re-invested in consols at 93. How much would he have lost in income had he accepted the first proposal, and what will he now gain by the new investment? (*Barnard Smith.*)

Income in 1st case = 3% on £10,000
= £300;
" 2nd " = 2½% on £11,000
= £275;
" 3rd " = $\frac{1}{93}$ of £10,000
= $\frac{1}{31}$ of £10,000
= £322 11s. 7$\frac{11}{31}$d.
∴ Loss by first proposal = £300 − £275
= £25. Ans.
∴ Gain by second proposal = £322 11s. 7$\frac{11}{31}$d. − £300
= £22 11s. 7$\frac{11}{31}$d. Ans.

7. INQUIRER.—Find the true discount on £755 5s. 9d., drawn March 17th at 3 months, discounted May 31st, at 6 per cent. (*Colenso.*)

Bill is due on June 20th.
No. of days from May 31st to June 20th = 20.
Interest on £100 for 20 days = $\frac{20}{365}$ of £6
= £$\frac{24}{365}$.

£ £ s. d. £
∴ 100½ : 755 5 9 :: ⅔ : True Discount

73 24
7324) 18126 18 0 (2£
14648
3478
20
69578 (9s.
65916
3662

∴ True Discount = £2 9s. 6d. Ans.

8. TUCELA.—Two boys A and B start together from the same point and walk round and round a ring fence in opposite directions, till they meet at the starting point; their last meeting place before this was 990 yards from it. A's rate being to B's rate as 5 : 3, find the distance covered by each.

While B walks 990 yards, A walks 950 yards × ⅝ = 1650 yards.

Distance round the fence = (990 + 1650) yards
= 2640 yards
= 1½ miles;

∴ Distance covered by A = (1½ × 5) miles = 7½ miles
" " B = (1½ × 3) " = 4½ " } Ans.

9. TED.—A person invests £1037 10s. in the 3 per cents. at 83, and when the funds have risen 1 per cent. he transfers his capital to the 4 per cents. at 96. Required the alteration in his income. (*Barnard Smith.*)

Stock in 1st case = £1037½ × 100/83
= 25/83 × 1250 £
= £1250;
Income " " = 3% on £1250
= £37 10s.:
Stock in 2nd case = £1250 × 84/96
= £1250 × ⅞
= £1093¾;
Income " " = 4% on £1093¾
= £43·75
= £43 15s.:
∴ Alteration in income = £43 15s. — £37 10s.
= £6 5s. increase. Ans.

10. DONETTE.—What difference in income is made by transferring £4275 from 4 per cents. at 80 to 5½ per cents. at 90?

Income in 1st case = 4% on £4275
= £171:
Stock in 2nd case = £4275 × 80/90
= £3800;
Income " " = 5½% on £3800
= £38 × 5½
= £209:
∴ Difference in income = £209 — £171
= £38 increase. Ans.

11. FERN, Carlisle.—A company whose capital is £2,500,000 pays 6½ per cent. per annum to shareholders, clear of income tax at 4d. in the £; find total receipts, expenses being 60 per cent. of gross receipts. (*Johnston's Civil Service Arithmetic.*)

Dividend without income-tax = 6½ % on £2,500,000
= £25,000 × 6½
= £162,500;
" with " = £162,500 × £1 / 19s. 8d.
= £162,500 × 240/236
= £165,254·237;

Expenses = 60 % or ⅗ of gross receipts;
∴ Dividend = ⅖ of gross receipts:
∴ Annual receipts = Dividend × 5/2
= £(165,254·237 × 5/2)
= £413,135·592
= £413,135 11s. 10⅝d. Ans.

12. P. WATTS.—If a person transfer from the 3 per cent. stock at 73½ to the 3½ per cents. at 81½, he would increase his income £4 10s.; how much stock has he in the 3 per cents.?

Income on £100 stock in 3 per cents. = £3;
" " " " when transferred to 3½ per cents. = £3½ × 73½/81½
= £3½ × 147/163
= £(7/2 × 3/163)
= £3 21/326;
Increase in income = 21/326 £;
∴ Stock in 3% ... = £100 × 4½ £ / 21/326 £
= £100 × 30
= £3000. Ans.

Note.—Elliot's *Mensuration*, 2s. (Hughes.)

13.—LIOC.—I have shares amounting to ⅜ of a property worth £126 14s. 1d., and after purchasing additional shares worth ⅛ of my own, I sell 1/13 of my whole interest in the property. What share have I left, and what is it worth? Express both results in decimals.

Share left = 3/13 of ⅜ of ⅞
= 9/104
= 9/13
= ·230769. Ans.
Value = 9/13 of £126 14s. 1d.
= 1/13 of £380 2s. 3d.
= 1/13 of £380·1125
= £29·23942 30769. Ans.

14. ALVESTON.—If 3 cows or 7 horses can eat the produce of a field in 29 days, in how many days will 7 cows and 3 horses eat it up? (*Barnard Smith.*)

3 cows can eat as much as 7 horses,
∴ 1 cow " " 7/3 "
7 cows " " 7/3 × 7 "
= 16⅓ "
7 cows and 3 horses " 19⅓ " :
7 horses can eat the produce of the field in 29 days,
∴ 1 horse " " " " (29 × 7) "
And 19⅓ horses " " " 29 × 7 / 19⅓ "
= 29 × 7 × 3 / 58 / 2 "
= 21/2 days
= 10½ days. Ans.

15. ALPHA.—What must be the price of 3 per cent. stock in order that, after deducting an income-tax of 7d. in the pound, the dividend received may be equal to 3⅓ per cent. on the sum invested?

s. d. £ s. d. £
As 19 5 : 3 6 8 :: 1 : Percentage with income-tax.

12 20
233 66
12
800
£3 10/233.

£ £ £
∴ 3 10/233 : 3 :: 100 : Price of stock
233 233/699
800
= 87½. Ans.

16. R. B.—A publisher wishes to net 14s. for each copy of a work; what price should he put upon it so as to be able to allow the trade 30 per cent. discount?

£100 − £30 = £70.
£ £ £
∴ 70 : 14 :: 100 : Selling price
2
= £1. Ans.

17. SHAWN.—The sum of two numbers is 104; ⅜ of the greater number is equal to the difference between them. Find the numbers.

As the difference between the two Nos. = ⅜ of greater No.,
∴ Lesser No. = ⅜ of greater No.

Greater No. + Lesser No. = 104
Greater No. + $\frac{2}{3}$ of greater No. = 104
$\frac{5}{3}$ of greater No. = 104
∴ Greater No. = $\frac{3}{5}$ of 104
= 64;
And lesser No. = 40. } Ans.

18. VESUVIUS.—Assuming the purchasing value of shillings, marks, and florins, to be 689 : 645 : 1345; find the loss on a draft for £100 if $\frac{3}{11}$ is paid in shillings, $\frac{1}{11}$ in marks, and the rest in florins, reckoning 20 marks and 10 florins to the pound. (*Certificate Examination*, 1880.)

Part in florins = $1 - (\frac{3}{11} + \frac{1}{11})$
$= 1 - \frac{390+341}{990}$
$= 1 - \frac{731}{990}$
$= \frac{259}{990}$.
Loss per mark = $(1 - \frac{344}{345})$s. = $\frac{44}{345}$s.;
No. of marks = $\frac{1}{11}$ of 2000
= $\frac{2000}{11}$;
Loss on marks = $\left(\frac{2000}{11} \times \frac{44}{345}\right)$ s.
$= \frac{8000}{1035}$s.;
Loss per florin = $(2 - \frac{1345}{690})$s. = $(2 - 1\frac{259}{690})$s.
= $\frac{341}{690}$s.;
No. of florins = $\frac{259}{990}$ of 1000
= $\frac{259000}{990}$;
Loss on florins = $\left(\frac{25900}{99} \times \frac{341}{690}\right)$s.
$= \frac{2590000}{2067}$s.;
∴ Total loss = $(\frac{8000}{1035} + \frac{2590000}{2067})$s.
$= \frac{104000 + 25900}{2067}$s.
$= \frac{129900}{2067}$s.
= £3 2s. $10\frac{94}{689}$d. Ans.

19. CUTHBERT.—An empty cistern has two supplying pipes, A and B, and two taps, C and D. A would fill the cistern in $42\frac{1}{2}$ minutes, B in 46 minutes, and D can carry off per minute half as much again as C. After A and B, running together, have supplied a certain quantity, C is allowed to run with them, and takes 51 minutes to empty the cistern: but, had D been turned along with C, the two would only have taken $5\frac{3}{4}$ minutes to empty it. In what time would the cistern have been emptied if D had been turned on instead of C, and how much of the cistern was filled when C was set open?

Part filled by A and B in 1 min. = $\frac{2}{85} + \frac{1}{46} = \frac{92+85}{3910}$
$= \frac{177}{2010}$;
Part emptied by C and D ,, = $\frac{4}{23}$ of part filled + $\frac{177}{2010}$,
,, ,, C ,, = $\frac{1}{51}$,, ,, + $\frac{177}{2010}$,
∴ ,, ,, D ,, = $(\frac{2}{23} - \frac{1}{51})$ of part filled
$= \frac{204-23}{1173}$,, ,,
$= \frac{181}{1173}$ of part filled;
But part emptied by D in 1 min. = $\frac{1}{2}$ times part emptied by C in 1 min.;
∴ $\frac{181}{1173}$ of part filled = $\frac{1}{2}$ ($\frac{1}{51}$ of part filled + $\frac{177}{2010}$)
$\frac{181}{1173}$,, ,, = $\frac{1}{102}$,, ,, + $\frac{531}{7820}$
$(\frac{181}{1173} - \frac{1}{102})$ of part filled = $\frac{531}{7820}$
$\frac{362-69}{2346}$,, ,, = $\frac{531}{7820}$
$\frac{293}{2346}$,, ,, = $\frac{531}{7820}$
∴ Part filled = $\frac{531}{7820} \times \frac{2346}{293}$
$= \frac{1593}{7820}$. Ans.

Part emptied by D in 1 min. = $\frac{181}{1173}$ of $\frac{531}{2930}$
$= \frac{96111}{3436890}$;
∴ If D had been turned on instead of C, the cistern would have been emptied in
$\{\frac{1593}{7820} \div (\frac{96111}{3436890} - \frac{177}{2010})\}$ min.
$= (\frac{1593}{7820} \div \frac{96111 - 51861}{1145630})$ min.
$= \left(\frac{\overset{9}{1593}}{\underset{1565}{7820}} \times \frac{\overset{391}{1145630}}{\underset{250}{44250}}\right)$ min.
$= \frac{3519}{250}$ min.
$= 14\frac{19}{250}$ min.
= 14·076 min. Ans.

20. KIRKHAM.—A cubical space containing 941,192 cubic inches is exactly fitted by 64 cubical boxes, find the length of the side of each box. (*Scholarship*, 1876.)

Cubical content of each box = $\frac{941192}{64}$ cub. in.
= $\frac{117649}{8}$ cub. in.:
∴ Side of each box = $\sqrt[3]{\frac{117649}{8}}$ cub. in.

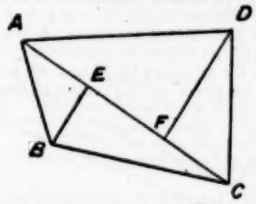
$\sqrt{117649}$ (49
64
$4^2 \times 300 = 4800$ | 53649
$4 \times 9 \times 30 = 1080$
$9^2 = 81$
5951 | 53649
$= \frac{49}{8}$ in.
= $24\frac{1}{2}$ in. Ans.

21. MATHEMATICUS.—What sum of money must be divided among A, B, C, so that A may have 6s. and C 9s. $4\frac{1}{2}$d., and that B may have as much per cent. more than A, as C has more than B? (*Colenso.*)

B's share = A's share × $\frac{100 + \text{Percentage}}{100}$
C's share = B's share × $\frac{100 + \text{Percentage}}{100}$
= A's share × $\frac{100 + \text{Percentage}}{100} \times \frac{100 + \text{Percentage}}{100}$
= A's share × $\left(\frac{100 + \text{Percentage}}{100}\right)^2$
A's share × $\left(\frac{100 + \text{Percentage}}{100}\right)^2$ = C's share
$\left(\frac{100 + \text{Percentage}}{100}\right)^2$ = $\frac{\text{C's share}}{\text{A's share}}$
= $\frac{9s.\ 4\frac{1}{2}d.}{6s.}$
= $\frac{81}{16}$
∴ $\frac{100 + \text{Percentage}}{100}$ = $\sqrt{\frac{81}{16}}$
= $\frac{9}{4}$.
B's share = A's × $\frac{100 + \text{Percentage}}{100}$
= 6s. × $\frac{9}{4}$
= 7s. 6d.
∴ Sum = 6s. + 7s. 6d. + 9s. $4\frac{1}{2}$d.
= £1 2s. $10\frac{1}{2}$d. Ans.

Mensuration.

1. J. KEEFE, F.S.A.—Find the area in ac., ro., and po., of a quadrilateral ABCD from the following data:—AB = 110 yds., AD = 220 yds., AC = 264 yds., and the perpendiculars from B and D upon AC divide it into three equal parts.



AE = $\frac{1}{3}$ of AC = 88 yds.; AF = $\frac{2}{3}$ of AC = 176 yds.
$DF^2 = AD^2 - AF^2$
$= 220^2 - 176^2$
$= 48400 - 30976$
$= 17424$
∴ DF = 132.

$BE^2 = AB^2 - AE^2$
$= 110^2 - 88^2$
$= 12100 - 7744$
$= 4356$
$\therefore BE = 66.$

Area of quadrilateral $ABCD = \frac{AC \times (DF + BE)}{2}$
$= \frac{264 \times (132 + 66)}{2}$ sq. yds.
$= (132 \times 198)$ sq. yds.
$= \frac{\cancel{12} \times \cancel{18} \times 4}{\cancel{12}\ \cancel{18}}$ po.
$= 864$ po.
$= 21$ ro. 24 po.
$= 5$ ac. 1 ro. 24 po. Ans.

Note.—Your solution of the Arithmetical query in our last issue is correct, but you say the difference £1 is the interest on the discount for 9 *months*, whereas it should be 1 *year*.

2. MUDDLED.—How many feet of boarding will be required for a roof 72 ft. long, and $19\frac{1}{10}$ ft. deep, the boards being 9 ft. long and $5\frac{1}{2}$ in. deep, if the longer edge of each is laid horizontally, and overlaps the lower board by $\frac{3}{4}$ of an inch? (*Scholarship*, 1879.)

Quantity of boarding = 72 ft. $\times$ $19\frac{1}{10}$ ft. $\div$ ($5\frac{1}{2}$ in. $-$ $\frac{3}{4}$ in.)
$= \left(\frac{\cancel{72}^{9}}{1} \times \frac{305}{\cancel{10}_{2}}\right)$ sq. ft. $\div 4\frac{3}{4}$ in.
$= \frac{2745}{2}$ sq. ft. $\div \frac{19}{24}$ ft.
$= \left(\frac{2745}{\cancel{2}} \times \frac{\cancel{48}^{24}}{19}\right)$ ft.
$= \frac{65880}{19}$ ft.
$= 3,467\frac{7}{19}$ ft.; or,
$(3,467\frac{7}{19} \div 9) = 385\frac{5}{19}$ pieces 9 ft. long.

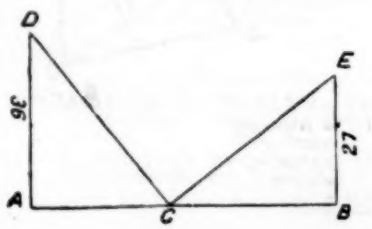
3. T. H. WILLIAM.—Find the content of a ring whose section is 9 inches square, and outside diameter 6 feet.

Inside diameter = 6 ft. $-$ 9 in. = 5 ft. 3 in.
Content of ring = $[\{(6)^2 - (5\frac{1}{4})^2\} \times \cdot 7854]$ sq. ft. $\times$ 9 in.
$= \{(6 + 5\frac{1}{4}) \times (6 - 5\frac{1}{4}) \times \cdot 7854 \times \frac{3}{4}\}$ cub. ft.
$= (11\frac{1}{4} \times \frac{3}{4} \times \cdot 7854 \times \frac{3}{4})$ cub. ft.
$= \left(\frac{\cancel{45}^{9}}{4} \times \frac{3}{\cancel{4}} \times \frac{3927}{\cancel{5}\cancel{0}\cancel{0}\cancel{0}} \times \frac{3}{\cancel{4}}\right)$ "
$= \frac{317655}{64000}$ cub. ft.
$= 4\frac{29655}{64000}$ cub. ft.
$= 4$ cub. ft. 1,676·349 in. Ans.

4. ALASCO.—The difference between the areas of two squares inscribed and circumscribed about a circle is 338 sq. ft. Find the radius of the circle.

Circumscribed square is double inscribed square.
$\therefore$ Area of circumscribed square $= (338 \times 2)$ sq. ft.
$= 676$ sq. ft.
But " " $=$ Diameter^2;
$\therefore$ Diameter$^2 = 676$ sq. ft.
Diameter $= \sqrt{676 \text{ sq. ft.}}$
$= 26$ ft.
$\therefore$ Radius $= 13$ ft. Ans.

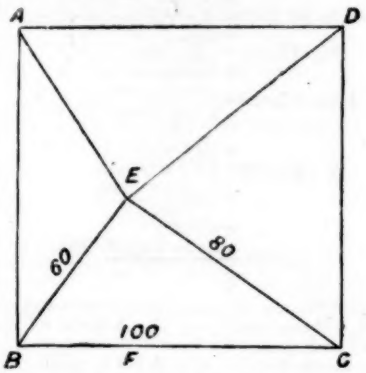
5. ALBION.—A ladder, whose foot rests in a given position, just reaches a window on one side of a street, and when turned about, its foot just reaches a window on the other side. If the two positions of the ladder be at right angles to each other, and the heights of the windows be 36 and 27 feet respectively, find the width of the street and the length of the ladder.



The angles ACD, ADC are together equal to a right angle; (I. 32.)
the angles ACD, BCE are together equal to a right angle; (I. 13.)
$\therefore$ The angle ADC = the angle BCE:
In the triangle ADC, CBE,
the angles CAD, ADC = the angles EBC, BCE,
and the side CD = side CE;
$\therefore$ AC = BE, and AD = CB: (I. 26.)
$\therefore$ AC = 27, and CB = 36;
$\therefore$ Width of street = (27 + 36) ft. = 63 ft. Ans.

$CD^2 = AD^2 + AC^2$ (I. 47)
$= 36^2 + 27^2$
$= 1296 + 729$
$= 2025$
$\therefore CD = \sqrt{2025}$
$= 45.$
$\therefore$ Length of ladder = 45 ft. Ans.

6. FOLKESTONIAN.—The side of a square is 100 feet; a point is taken inside the square which is distant 60 feet and 80 feet respectively from the two ends of a side; find the areas of the four triangles formed by joining the point to the four corners of the square. (Todhunter's Mensuration.)



$EF^2 = BE^2 - BF^2 = 60^2 - BF^2$, (I. 47.)
And $EF^2 = CE^2 - CF^2 = 80^2 - CF^2 = 80^2 - (100 - BF)^2$
$= 6400 - 10000 + 200\ BF - BF^2$
$= 200\ BF - BF^2 - 3600;$
$\therefore 200\ BF - BF^2 - 3600 = 3600 - BF^2$ (Ax. 1.)
$200\ BF = 7200$
$\therefore BF = 36.$
$EF^2 = 60^2 - BF^2 = 60^2 - 36^2 = 3600 - 1296$
$= 2304$
$\therefore EF = \sqrt{2304} = 48.$

Area of triangle BEC $= \frac{BC \times EF}{2} = \left(\frac{100 \times 48}{2}\right)$ sq. ft.
$= 2400$ sq. ft.;
" " " AED $= \frac{1}{2}$ area of square $-$ area of triangle BEC
$= (5000 - 2400)$ sq. ft.
$= 2600$ sq. ft.;
" " " AEB $= \frac{AB \times BF}{2} = \frac{100 \times 36}{2}$ sq. ft.
$= 1800$ sq. ft.;
" " " CED $= (5000 - 1800)$ sq. ft.
$= 3200$ sq. ft. Ans.

Algebra.

1. T. D.—Find a number, such, that whether it be divided into 2 or 3 equal parts, the continued product of the parts is the same.

Let x = the no.;
Then $\frac{x}{2} \times \frac{x}{2} = \frac{x}{3} \times \frac{x}{3} \times \frac{x}{3}$
$\frac{x^2}{4} = \frac{x^3}{27}$
Dividing by x^2 $\Big\}$ $\frac{1}{4} = \frac{x}{27}$
$\therefore x = \frac{27}{4}$
$= 6\frac{3}{4}.$

2. IN A FIX.—Solve the equation :—$5x^3 - 56 = 6x^{\frac{3}{2}}$.

$$5x^3 - 56 = 6x^{\frac{3}{2}}$$
$$5x^3 - 6x^{\frac{3}{2}} = 56$$
$$x^3 - \tfrac{6}{5}x^{\frac{3}{2}} = \tfrac{56}{5}$$
$$x^3 - \tfrac{6}{5}x^{\frac{3}{2}} + (\tfrac{3}{5})^2 = \tfrac{56}{5} + \tfrac{9}{25} = \tfrac{289}{25}$$
$$x^{\frac{3}{2}} - \tfrac{3}{5} = \pm\tfrac{17}{5}$$
$$x^{\frac{3}{2}} = \pm\tfrac{17}{5} + \tfrac{3}{5} = 4 \text{ or } -\tfrac{14}{5}$$
$$x^3 = 16 \text{ or } \tfrac{196}{125}$$
$$\therefore x = \sqrt[3]{16} \text{ or } \sqrt[3]{\tfrac{196}{125}} = 2\sqrt[3]{2} \text{ or } \tfrac{14}{5}\sqrt[3]{\tfrac{2}{125}}.$$

3. AGIER.—Find a, b, c so that each of the two following expressions may be perfect squares:—$x^4 + ax^3 + bx^2 + cx + 1$ and $x^4 + 2ax^3 + 2bx^2 + 2cx + 1$. (*Intermediate Arts, London University*, 1881.)

$$x^4 + ax^3 + bx^2 + cx + 1 \Big(x^2 + \tfrac{a}{2}x + 1$$
$$x^4$$
$$2x^2 + \tfrac{a}{2}x \;\Big|\; ax^3 + bx^2$$
$$ax^3 + \tfrac{a^2}{4}x^2$$
$$2x^2 + ax + 1 \;\Big|\; \left(b - \tfrac{a^2}{4}\right)x^2 + cx + 1$$
$$\left(b - \tfrac{a^2}{4}\right)x^2 + cx + 1$$
$$\therefore b - \tfrac{a^2}{4} = 2, \text{ and } c = a.$$

$$x^4 + 2ax^3 + 2bx^2 + 2cx + 1 (x^2 + ax + 1$$
$$x^4$$
$$2x^2 + ax \;\Big|\; 2ax^3 + 2bx^2$$
$$2ax^3 + a^2x^2$$
$$2x^2 + 2ax + 1 \;\Big|\; (2b - a^2)x^2 + 2cx + 1$$
$$(2b - a^2)x^2 + 2cx + 1$$
$$\therefore 2b - a^2 = 2, \text{ and } 2c = 2a.$$

$$\left.\begin{aligned} b - \tfrac{a^2}{4} &= 2 \\ 2b - a^2 &= 2 \end{aligned}\right\} \quad \left.\begin{aligned} 2b - a^2 &= 2 \\ 6 - a^2 &= 2 \\ a^2 &= 4 \\ \therefore a &= 2 \\ c = a &= 2 \end{aligned}\right\}$$
$$\left.\begin{aligned} 4b - a^2 &= 8 \\ 2b - a^2 &= 2 \end{aligned}\right\}$$
$$2b = 6$$
$$\therefore b = 3.$$

$$\therefore a = 2,\ b = 3,\ c = 2. \quad \text{Ans.}$$

Note.—We have not received any other queries from you.

4. DOMINICA.—A train, an hour after starting, meets with an accident which detains it an hour, after which it proceeds at $\frac{3}{5}$ of its former rate, and arrives 3 hours behind time; but had the accident happened 50 miles farther on the line, it would have arrived an hour and twenty minutes sooner. Find length of line.

Let x = length of line in miles,
And y = original rate of train per hour in miles;
Then $x - y$ = distance left after accident,
And $\frac{x-y}{\frac{3}{5}y}$ = no. of hrs. required to travel this distance.

$$\therefore 2 + \frac{x-y}{\frac{3}{5}y} = \frac{x}{y} + 3. \quad (1)$$

If the accident had happened 50 miles further on,
Then $1 + \frac{50}{y}$ = no. of hrs. before accident,
And $x - y - 50$ = distance left after accident.

$$\therefore 2 + \frac{50}{y} + \frac{x-y-50}{\frac{3}{5}y} = \frac{x}{y} + 3 - 1\tfrac{1}{3}. \quad (2)$$

Multiplying by $3y$:
(1) $6y + 5(x - y) = 3x + 9y$
(2) $6y + 150 + 5(x - y - 50) = 3x + 5y$
(1) $6y + 5x - 5y = 3x + 9y$
(2) $6y + 150 + 5x - 5y - 250 = 3x + 5y$
(1) $2x - 8y = 0$
(2) $2x - 4y = 100$
(1) $x - 4y = 0$
(2) $2x - 4y = 100$
$\therefore x = 100$

$\therefore$ Length of line = 100 miles. Ans.

Note.—Writing *very good*.

5. NIL DESPERANDUM.—A cistern can be filled in 15 minutes by two pipes, A and B, running together; after A has been running by itself for 5 minutes, B is also turned on, and the cistern is filled in 13 minutes more. In what time would it be filled by each pipe separately? (*Colenso's Algebra.*)

Let x = no. of min. it takes A to fill the cistern,
Then $\frac{1}{x}$ = part filled by A in 1 min.;

$$\therefore \frac{5}{x} + \frac{13}{15} = 1$$
$$\frac{5}{x} = 1 - \tfrac{13}{15} = \tfrac{2}{15}$$
$$2x = 75$$
$$\therefore x = 37\tfrac{1}{2}$$

Part filled by B in 1 min. $= \frac{1}{15} - \frac{1}{x} = \frac{1}{15} - \frac{2}{75} = \frac{3}{75}$.

$\therefore$ A could fill the cistern in $37\frac{1}{2}$ min. and B in 25 min. Ans.

6. MOEL FAMMAN.—A and B exchange purses; A has as many half-sovereigns as B has half-crowns, and as many sixpences as B as shillings; find the ratio of the number of half-sovereigns to the number of sixpences, so that neither may lose by the exchange. (*Scholarship*, 1877.)

Let x = no. of half-sovereigns in A's purse,
And y = " sixpences in A's purse;
Then $20x + 2y$ = value of the money in A's purse in sixpences,
And $5x + 2y$ = " B's " " ;

$$\therefore 20x + y = 5x + 2y$$
$$20x - 5x = 2y - y$$
$$15x = y.$$

$\therefore$ The number of half-sovereigns is to the number of sixpences in the ratio of 1 to 15. Ans.

7. JUNIOR.—Find x from the following equation :—

$$\left(a^{\frac{1}{2}} + x^{\frac{1}{2}}\right)^{\frac{1}{3}} = \left(a^{\frac{1}{3}} + x^{\frac{1}{3}}\right)^{\frac{1}{2}}.$$
$$\left(a^{\frac{1}{2}} + x^{\frac{1}{2}}\right)^{\frac{1}{3}} = \left(a^{\frac{1}{3}} + x^{\frac{1}{3}}\right)^{\frac{1}{2}}$$

Raise both sides to the sixth power:
$$\left(a^{\frac{1}{2}} + x^{\frac{1}{2}}\right)^2 = \left(a^{\frac{1}{3}} + x^{\frac{1}{3}}\right)^3$$
$$a + 2a^{\frac{1}{2}}x^{\frac{1}{2}} + x = a + 3a^{\frac{2}{3}}x^{\frac{1}{3}} + 3a^{\frac{1}{3}}x^{\frac{2}{3}} + x$$
$$2a^{\frac{1}{2}}x^{\frac{1}{2}} = 3a^{\frac{2}{3}}x^{\frac{1}{3}} + 3a^{\frac{1}{3}}x^{\frac{2}{3}}$$

This is satisfied by $x = 0$

Divide each side by $a^{\frac{1}{3}}x^{\frac{1}{3}}$:
$$2a^{\frac{1}{6}}x^{\frac{1}{6}} = 3a^{\frac{1}{3}} + 3x^{\frac{1}{3}}$$
$$3x^{\frac{1}{3}} - 2a^{\frac{1}{6}}x^{\frac{1}{6}} = -3a^{\frac{1}{3}}$$
$$x^{\frac{1}{3}} - \frac{2a^{\frac{1}{6}}x^{\frac{1}{6}}}{3} = -a^{\frac{1}{3}}$$
$$x^{\frac{1}{3}} - \frac{2a^{\frac{1}{6}}x^{\frac{1}{6}}}{3} + \left(\frac{a^{\frac{1}{6}}}{3}\right)^2 = -a^{\frac{1}{3}} + \frac{a^{\frac{1}{3}}}{9}$$
$$= -\frac{8a^{\frac{1}{3}}}{9}$$
$$x^{\frac{1}{6}} - \frac{a^{\frac{1}{6}}}{3} = \pm\frac{a^{\frac{1}{6}}\sqrt{-8}}{3}$$
$$x^{\frac{1}{6}} = \frac{a^{\frac{1}{6}}\left(1 \pm \sqrt{-8}\right)}{3}$$
$$\therefore x = \frac{a\left(1 \pm \sqrt{-8}\right)^6}{3^6}, \text{ or } 0.$$

8. J. EDWARDS, Burton-on-Trent.—A flock of 37 sheep (wethers and ewes) was sold for £89 1s., a ewe fetching $\frac{4}{5}$ of the price of a wether. Altogether the ewes fetched £4 11s. more than the wethers. How many wethers were there, and what did each sell for?

Amount for wethers = $\frac{1}{2}$ of (£89 1s. − £4 11s.)
= $\frac{1}{2}$ of £84 10s.
= £42 5s.;
And " ewes = £42 5s. + £4 11s.
= £46 16s.

Let x = price of a wether in shillings,
Then $\frac{3x}{5}$ = " " ewe " " ;

$\therefore$ £42 5s. $\div x$ or $\frac{845}{x}$ = No. of wethers,

And £46 16s. $\div \frac{3x}{5}$ or $\frac{1560}{x}$ = " ewes;

$$\therefore \frac{845}{x} + \frac{1560}{x} = 37$$

$$2405 = 37x$$

$$\therefore x = 65.$$

$\therefore$ Price of a wether = 65s. = £3 5s.; No. of wethers = $\frac{845}{65}$ = 13. } Ans.

9. WINTON.—From each of a number of foreign gold coins a person filed a fifth part, and had passed $\frac{3}{4}$ of them, gaining thereby 52s. 6d., when the rest were seized as light coin, except one with which the man decamped, having lost upon the whole $\frac{1}{3}$ as much as he had gained before: how many coins were there at first? (Colenso.)

First Method.

Gain on $\frac{3}{4}$ of the coins = 52s. 6d.,

" all " " = 52s. 6d. $\times \frac{4}{3}$

= £4$\frac{1}{2}$;

$\therefore$ Value of the coins = £4$\frac{1}{2} \times 5$

= £$\frac{175}{8}$.

Let x = No. of coins;

Then $\frac{175}{8x}$ = value of each coin in pounds,

And $\frac{1}{3}$ of $\frac{175}{8x}$ or $\frac{35}{2x}$ = loss on each coin seized;

Loss on the coins seized = 52s. 6d. + $\frac{1}{3}$ of 52s. 6d.

= $\frac{4}{3}$ of £2$\frac{1}{2}$

= $\left(\frac{7}{3}$ of $\frac{77}{8}\right)$ £

= £$\frac{49}{8}$.

$$\therefore \left(\frac{2x}{5} - 1\right) \times \frac{35}{2x} = \frac{49}{8}$$

$$\frac{2x-5}{5} \times \frac{7}{x} = \frac{7}{8}$$

$$\frac{2x-5}{x} = \frac{7}{8}$$

$$8x - 20 = 7x$$

$$8x - 7x = 20$$

$$\therefore x = 20.$$

$\therefore$ No. of coins = 20. Ans.

Second Method.

Gain on each coin passed = $\frac{1}{4}$ of its value,

Loss " seized = $\frac{1}{3}$ " "

$$\therefore \left(\frac{2x}{5} - 1\right) \times \frac{1}{4} = \frac{7}{3} \text{ of } \frac{2x}{5} \times \frac{1}{3}$$

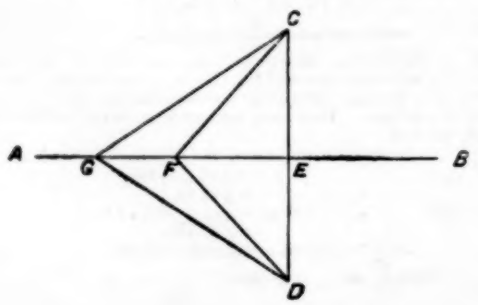
$$\frac{4(2x-5)}{25} = \frac{7x}{25}$$

$$8x - 20 = 7x$$

$$\therefore x = 20.$$

Geometry.

1. O. H. F.—From every point of a given line, the lines drawn to each of two given points on opposite sides of the line are equal. Prove that the line joining the given points will be bisected by the given line at right angles.



Let AB be the given line, and C, D the given points. Draw the lines FC, FD, GC, GD, from any two points F, C in AB, and join CD.

Then, if FC be equal to FD, and GC equal to GD, CD will be bisected at right angles by AB.

Proof.—In the triangles CGF, DGF,

the sides CG, GF = the sides DG, GF, each to each,

and the base CF = the base DF,

$\therefore$ $\angle$CGF = $\angle$DGF. (I. 8.)

Again, in the triangles CGE, DGE,

the sides CG, GE = the sides DG, GE, each to each,

and the $\angle$CGE = the $\angle$DGE;

$\therefore$ the base CE = the base DE, (I. 4.)

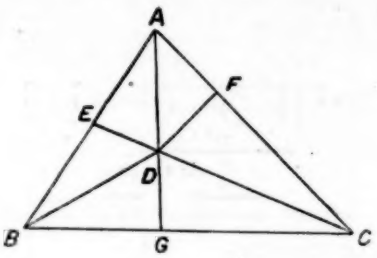
and $\angle$CEG = $\angle$DEG;

and these are adjacent angles;

$\therefore$ AB is at right angles to CD. (Def. 10.)

Wherefore CD is bisected at right angles by AB.—Q.E.D.

2. BINK.—Show that the lines bisecting the angles of any triangle meet in a point.



Let ABC be a triangle, then the lines bisecting the angles will will meet in a point.

Bisect the angles ABC, ACB by straight lines meeting in D (I. 9), join AD.

Then AD shall bisect the angle BAC.

Draw DE, DF, DG perpendicular to AB, AC, BC, respectively. (I. 12.)

Proof.—In the triangles BDE, BDG,

the $\angle$DBE = the $\angle$DBG, (Hyp.)

the $\angle$DEB = the $\angle$DGB, (Ax. 11,)

and the side BD is common to the two triangles.

$\therefore$ side DE = side DG. (I. 26.)

Similarly it can be proved that DF = DG.

$\therefore$ DE = DF. (Ax. 1.)

Again, $AD^2 = DE^2 + AE^2$, (I. 47.)

and $AD^2 = DF^2 + AF^2$;

but DE = DF;

$\therefore$ AE = AF.

In the triangles EAD, FAD,

the sides EA, AD = the sides FA, AD, each to each,

and the base ED = the base FD,

$\therefore$ $\angle$EAD = $\angle$FAD. (I. 8.)

Wherefore the lines bisecting the angles of the triangle meet in a point.—Q.E.D.

General.

1. L. M. N.—Write to the Civil Service Commissioners, Cannon Row, S.W., who will give you the necessary information.

2. STUDENT, Newcastle.—Apply to Messrs. W. and R. Chambers, Edinburgh.

3. WALLACE.—Writing very good.

4. STUDENT, Leicester.—Apply to the Principal of the College.

5. EX. P. T.—*Arnner's* 'Notes of Lessons and How to Write Them,' 2s. 6d. (Moffatt and Paige).

6. THE MOLE.—Four forces, 20, 20, 10, and 10, act upon a point; the angle between the first and second is 45°, the angle

between the second and third is 75°, and the angle between the third and fourth is 120°; find the resultant.—(*Newth's* 'Smaller Natural Philosophy.')

The resultant of the first and second forces bisects the angle between them (as the forces are equal) and

$$= 2 \times 20 \cos 44°$$
$$= 40 \cos 22\tfrac{1}{2}°$$
$$= 40 \times \cdot 9238795$$
$$= 36 \cdot 95518.$$

The resultant of the third and fourth forces bisects the angle between them and

$$= 2 \times 10 \cos 1\tfrac{1}{2}0°$$
$$= 20 \cos 60°$$
$$= 20 \times \tfrac{1}{2}$$
$$= 10.$$

∴ The resultant of the four forces

$$= \sqrt{\{(36 \cdot 95518)^2 + (10)^2 + 2 \times 36 \cdot 95518 \times 10 \cos (22\tfrac{1}{2}° + 75° + 60°)\}}$$
$$= \sqrt{(1365 \cdot 6853288324 + 100 + 739 \cdot 1036 \cos 157\tfrac{1}{2}°)}$$
$$= \sqrt{(1465 \cdot 6853288324 - 739 \cdot 1036 \cos 22\tfrac{1}{2}°)}$$
$$= \sqrt{(1465 \cdot 6853288324 - 739 \cdot 1036 \times \cdot 9238795)}$$
$$= \sqrt{(1465 \cdot 6853288324 - 682 \cdot 8426644162)}$$
$$= \sqrt{782 \cdot 8426644162}$$
$$= 27 \cdot 97932 \ldots \text{Ans.}$$

7. W. R., Kirkcaldy.—Any text-book on Trigonometry will give you the proof of $\sin (A+B) = \sin A \cos B + \cos A \sin B$.

Deduce that $2 \sin A \sin B = \cos (A-B) - \cos (A+B)$.

$$\text{Cos } (A-B) - \cos (A+B) = \cos A \cos B + \sin A \sin B - (\cos A \cos B - \sin A \sin B)$$
$$= \cos A \cos B + \sin A \sin B - \cos A \cos B + 2 \sin A \sin B$$
$$= 2 \sin A \sin B.$$

8. T. H. B.—As you say, the question is more algebraical than arithmetical. We do not think there is a simpler arithmetical solution. Your writing is very good indeed.

9. SUBSCRIBER.—Angus (*Religious Tract Society*), or Morris (*Macmillan and Co.*)

10. NESTA.—Yes.

11. LOL.—The Civil Service Commissioners, Cannon Row, S.W., will give *all* information required.

12. R. S.—(*a*) *Blackiston's* 'The Teacher': Hints on School Management, 2s. 6d. (Macmillan and Co.); *Gill's* 'Text Book on School Management,' 3s. (Longmans). (*b*) Scholarship and Certificate (First Year), 2 Books of Euclid; Certificate (Second Year), 4 Books.

13. W. E. EDWARDS.—Two solutions of your query were given in our issue for May. There is no arithmetical solution to the problem, and therefore the question ought not to be given in an arithmetical book.

14. EARNEST. — *Todhunter's* 'Mechanics for Beginners,' 4s. 6d. (Macmillan and Co.); *Elliott's* 'Mensuration,' 2s. (Hughes); Physics, *Balfour Stewart's* 'Elementary Physics,' 4s. 6d. (Macmillan).

15. SAM WELLER.—(*a*) Any time. (*b*) Civil Service Commissioners, Cannon Row, S.W.

16. PRECEPTOR.—The question, as you say, is worded very loosely. The great objection to parsing as commonly employed is that the pupil is apt, from the individual consideration he gives each word, to lose sight of the structure of the sentence as a whole, and the logical continuity of its parts. To prevent this, it is advisable that the pupil should be taught the leading facts concerning the Subject and Predicate, as soon as ever he has mastered the first elementary notions and definitions of Grammar. After being led to remark what kinds of words occur in the Subject, and what in the Predicate and its enlargements, he will feel more at home, as it were, in the *sentence*, and will have his interest and attention quickened in a study, which would otherwise appear dry and unprofitable.

17. AMATEUR.—Your suggestion shall be considered.

18. W. R.—*Hamblin Smith's* 'Elements of Geometry,' 3s. 6d. (Rivington). *Prof. Ellio?'s* 'Mensuration,' 2s. (Hughes). *Hamblin Smith's* 'Trigonometry,' 4s. 6d. (Rivington), or *Todhunter's*, 5s. (Macmillan). *Gray's* 'Poems,' edited by Francis Storr, M.A., 1s. (Rivington). *Hunter's* 'Richard III.,' 1s. (Longman's), or *Aldis Wright's*, 2s. 6d. (Clarendon Press.) *Xenophon's* 'Hellenica,' edited by H. Hailstone, B.A., 4s. 6d. (Macmillan.) We do not know of any newer edition of *Cicero's* 'De Finibus' than the one issued by Messrs. Rivington in *Arnold's* 'School Classics,' price 5s. 6d. The Cambridge University Press have one in hand, but we do not think it has yet appeared.

19. SEMPER FIDELIS.—

Sentence.	Kind.	Subject with Enlargements.	Verb.	Object with enlargements.	Extension of Predicate.	Connectives.
I. And should I leave behind The inviolate island of the sage and free	Subordinate sentence, Adverbial to VI.	I	should leave	The inviolate island of the sage and free	behind	And (if)
II. And seek me out a home by a remoter sea	,,	I	(should) seek	me (*indirect*) a home	by a remoter sea	and (if)
III. Perhaps I loved it well.	Sentence parenthetically inserted	I	loved	it	we'l Perhaps	
IV. And should I lay my ashes in a soil which is not mine,	Subordinate sentence, Adverbial to VI.	I	should lay	my ashes	in a soil *which is not mine*	and (if)
V. Which is not mine	Subordinate sentence, Adjectival to soil, in IV.	which	is	not mine		
VI. My spirit shall resume it.	Princ. sent.	My spirit	shall resume	it		
VII. if we may Unbodied choose a sanctuary.	Subordinate sentence, Adverbial to VI.	we unbodied	may choose	a sanctuary		if

20. UTOR NON ABUTOR.—Every word in a statement should admit of one construction, and *only* one. It is in this respect, we think, the sentence you send is faulty. If the words '*in writing, and speaking*' are inserted after the word '*expression*,' there will be a considerable gain in perspicuity and accuracy.

21. ACHATES.—*Forasmuch as*, a conjunctional phrase almost equivalent to *because*.

Then, Adverb. *What*, Interrogative Pronoun used adjectively, qualifying '*thing*' or '*manner of man*,' understood. *As*, a Conjunctive Adverb: (it might, without much error be classed as a preposition, equivalent to '*like to*,' and governing *Barnabas*.)

It, Personal Pronoun, Neuter Nominative to Verb. *came to pass*, used pleonastically (*i.e.* superfluously) for the sentence 'they went both together, etc.,' which is the real subject to the verb 'came to pass.'

That, a Subordinative Conjunction, joining the Sentences 'they went both,' etc., and 'It came to pass in Iconium.'

Both, Adjective, qualifying *men* understood.

Also, Adverb.

22. J. PRICE.—*Mrs. Wigley's* 'How I Teach Domestic Economy,' now appearing in the 'GOVERNESS,' will exactly meet your requirements.

23. R. P.—From the Civil Service Commissioners, Cannon Row, S.W.

24. J. GUILD.—(1) The National Society publish a good text-book on Botany. (2) Murray.

25. PUPIL TEACHER.—We cannot give you the necessary information.

26. J. W. BRAY.—The books you mention, with the one you already have, should enable you to pass well.

27. J. L. GIBSON.—It may be possible to solve your query, but the solution would be very difficult.

28. SYDNEY.—You must have the segments of the diagonal E B for the solution of your query.

29. E. CROSS.—If equal weights of two substances of different temperatures have, when mixed, a resulting temperature, which is a mean between the two, show that the specific heats of the substances are equal. (Newth.)

As the resulting temperature is a mean between the temperatures of the two substances, the heat lost by one substance is exactly gained by the other substance, and therefore their specific heats are equal.

30. A. P. T., Worthing.—Candidates have to read and sing at the *Scholarship Examination*, and have to provide themselves with writing materials, with the exception of paper.

31. ILFORD.—(1) After the second examination in that school if at least fifteen months' service and inspector's report favourable. (2) Second. (3) Only by examination. (4) No. (5) Number actually present at any attendance.

32. J. JEFFREY.—Get full syllabus for type of questions, price 6d. The papers are the same for acting teachers as for students.

33. PRECEPTOR.—A perusal of the series of articles on the 'Discipline of the Mind,' which is now appearing in the 'GOVERNESS,' will enable you to answer the question.

34. H. DURTRAM.—Apply to Mr. Thomas Murby, 23, Bouverie Street, who publishes a good work on the subject; or to Messrs. Longman for *Sutton's Manual*.

35. EX. P. T. STRANRAER.—Yes.

36. T. C., Walham Green.—*Agier* is simply the old form of *agi*, the passive infinitive of *ago*, and the phrase you quote means, '*to be carried out honestly amongst good men.*'

Eos hortatur ut secum copias jungant, dicens, tamen, se solum acturum esse, si timeant.

37. EYES FRONT.—

Colorem—Noun, 3rd dec., from *color, coloris*, masc., sing., acc., governed by *adhibeamus*.

Tegendis—Verb, from *tego, texi, tectum, tegere*, 3rd conj., fut. part. pass., plur., dat., neut., agreeing with *iis*.

Dissimulandis—parsed in a similar manner.

Adhibeamus—Verb from *adhibeo, bui, bitum*, 2nd conj., active, subj., pres., 1st pers. plur., agreeing with its subject *nos* understood.

Verum—Conjunction.

Quot-quot—Indeclinable adj, qualifying *ea*.

Ea—Pronoun, from *is, ea, id*, neut., plur. (*referring to peccata*), and nom. case to verb *sunt*.

Demisso—Perf. part. pass., from *demitto—misi—missum*, 3rd conj., neut., sing., ablative, agreeing with *corde*.

Obsequenti—Pres. part. of *obsequor, secutus sum*. Ablative, sing., neut., agreeing with *corde*.

Quo—Conjunction.

Veniam—Noun, from *venia, venix*, 1st dec., fem., sing., acc., governed by *consequamur*.

Consequamur—Verb deponent, from *consequor, consecutus sum*, 3rd conj., subj., pres., 1st per. plur., to agree with its subject *nos* understood

Training Colleges.

GENERAL EXAMINATION, 1881.

FIRST YEAR.

MALE AND FEMALE CANDIDATES.

Music *(continued)*

The Tonic Sol-fa questions are printed in Italic. Candidates must keep *entirely* to one set of questions or the other. *You are not permitted to answer more than* NINE *questions.*

5. *Make what alteration is required, so that the following shall appear in six-pulse measure.*

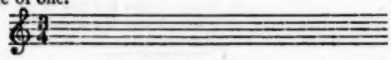
KEY C.

| s :l :s | d' :-.t :l.s | l.t :d' :r' | m' :— : ‖

6. Write in *a* the descending, and in *b* the ascending, diatonic scale of E (*Mi*) minor.

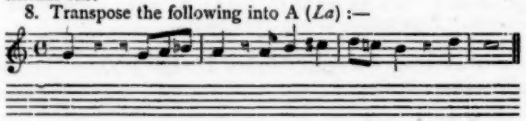
6. *Write scales in the minor modes of* RAY *and* ME, *and point out the difference between them.*

7. What is a triplet? Include in a measure of $\frac{3}{4}$ time an example of one.



7. *What is a triplet? Write a measure of time which shall include one.*

8. Transpose the following into A (*La*):—

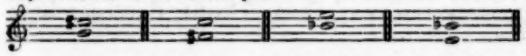


8. *Transpose the following into A* (Lah):—

KEY C.

| s . :,s.l,ta | l .,l :t .de' | r',d'.t : .r' | d' .—:—:— ‖

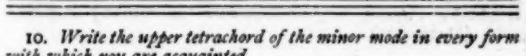
9. Write over each of the following intervals the name of the major scale of which it forms part.



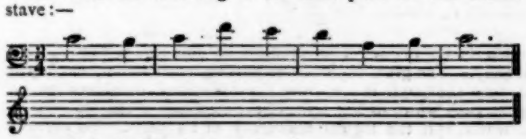
9. *To what transitions do each of the following intervals point?*

| de' :— | d' :— | m' :— | ta :— ‖
| s :— | fe :— | ta :— | m :— ‖

10. Write the upper tetrachord of C minor in every form with which you are acquainted.



10. *Write the upper tetrachord of the minor mode in every form with which you are acquainted.*

11. Write the following at the same pitch on the Treble stave:—

11. *Make the following an octave lower:—*

KEY F.

| s | d :d' | d' :t | l :s .f | m . : ‖

12. In what particular does a minor always differ from a major scale?

12. *In what particular does a minor always differ from a major scale?*

(To be continued.)

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Monthly Notes.

THE GENERAL ASSOCIATION OF CHURCH SCHOOL MANAGERS AND TEACHERS.—The tenth annual congress of the Church School Managers' and Teachers' Association was held in the Shire Hall, Gloucester, on the 1st and 2nd June, 1882. The proceedings commenced on the first day at a quarter to four in the afternoon, the Lord Bishop of Gloucester and Bristol presiding over a large meeting. Among those present were the Rev. Archdeacon Sheringham, Canon Gregory, Canon Spence, M. A. Nisbet, J. R. King, H. W. Maddy, B. St. John Ackers, Esq., H. D. Skrine, Esq., etc. The annual report and balance sheet having been taken as read and adopted, and a suggestion as to next year's place of meeting postponed till the following day, the Lord Bishop of Gloucester and Bristol proceeded to deliver his inaugural address. His lordship said:—

'I now at once address myself to the duty which you have kindly assigned to me of opening the Congress with a few introductory, or, as Mr. E. A. Freeman vigorously entreats us all never to say, "inaugural," words. Well, be the words introductory or inaugural, they may well be, in the main, words of sincere congratulation. In the first place, such an assembly as the present of united managers and teachers may rightly give us encouragement, and make us rejoice that common interests and a common and blessed work are bringing each year into closer and more cordial relations the managers of our church schools and that important body of Christian men on whom so much depends, both in the present and in the future—the teachers in our church schools, the makers of our future England (to use the recent words of Mr. Mundella) in the best and most pertinent sense of the words. There was a time, and that not very distant, when the close union of interests between managers and teachers was very imperfectly recognised; nay, even now, as I shall have hereafter to remark, co-operation may, in many cases, be more hearty and effective. There was once some cause for fear lest teachers should form, as it were, a separate corporation, and, to the great detriment of Christian education, should gradually segregate themselves in aims and interests from that body of men to whom our mother country owes a lasting debt of gratitude—the managers and chief supporters of our elementary Church schools. It is now, thank God, seen with increasing clearness that teachers and managers have a union, or rather, identity, of interests, which it would be simply suicidal for either party to attempt to disavow. Both have the one great and common object—the maintenance of religious teaching; both must have at heart the steady improvement and increasing efficiency of the school which is their common care; both practically find themselves to be united and one when relations with the Privy Council, hopes of new adjustment, or fears of New Codes remind them of the true nature and reality of their union. These things are now seen for the most part more clearly on both sides: and it is to meetings like the present, in which each discussion demonstrates the identity of interests, that teachers and managers together learn the old homely lesson that union is strength, and that in the nurturing of our children "in the chastening and admonition of the Lord" (as the Revised Version rightly has it) we are members one of another. The good that has been done in this great matter by the Association of Church School Managers and Teachers, and by each annual congress like the present, is simply incalculable. To those wise spirits who laid the foundations of this association, and devised the recurrence of these pleasant and profitable meetings, the Church of England and the sacred cause of religion generally owe a great debt of Christian gratitude. I may next allude in words not only of congratulation, but of hearty thankfulness to Almighty God, that, in spite of the general depression which has affected, as we know, to a large extent, the supporters of our country Church Schools, the progress in the past year has, nevertheless, proved to be distinctly encouraging.'

After some observations on the financial statements, standards of average attendance, general efficiency, etc., his Lordship concluded by saying that everywhere among church managers and teachers there must be

'vigour and promptitude. The call now is pressing, and the work to which we are called holy and patriotic. The future of the Church, the future of our country, the future of the dear children growing up around us, all depend upon our efforts at the present time more distinctly than at any other period in the past eleven years. If we would preserve our Church schools and our Church teaching, we must strengthen our weak places, and build up that which is decaying. There is time and there

is hope. God grant that we may wisely buy up the time, act upon the hope, and work onward with heartiness and courage!'

At the second session, held in the evening of the same day, the Bishop again presiding, the Rev. M. A. Nisbet read an able and suggestive paper on 'Night Schools.' He dwelt on the influence possessed by teachers and managers, and said that

'the future of the English race rested in the hands, humanly speaking, of the managers and teachers of the schools in England, and therefore very largely in their hands. If they rose to a true sense of their responsibilities—if in a catholic, charitable, and God-fearing spirit they educated those committed to their care—if in a loving and sympathetic spirit they gave of their time and strength to help them when, having left school, they were first exposed to the world's temptations—God would bless their efforts; their children would grow up as loyal citizens and faithful members of the Church of England; and all men—all who loved their country, and desired its real prosperity—would feel and acknowledge that it is indeed a most happy thing for the land that the teachers of our National Schools are an earnest body of men and women, and that our children are being trained by them in the fear and "admonition of the Lord."

The third session was opened by the Lord Bishop of Gloucester and Bristol on June 2nd, at ten o'clock. It was devoted chiefly to a discussion of the New Code, an admirable and discursive paper on which was read by the Rev. H. Roe, F.R.A.S. In the discussion which followed, Canon Gregory said that

'as regarded the New Code he welcomed it in every one of its stages. He thought it better than the old, but there was always a difficulty in changing from one system to another. He believed there had been no thought so much present in the mind of Mr. Mundella as that of the small country schools. He believed the framers of the New Code wished not to injure but to help small country schools. The new scheme offered an advantage in the matter of children being prevented from attending school through bad weather. In the long run teachers would find themselves better off in respect of difficulty of attendance.'

The fourth and concluding session of the Congress was held in the afternoon of June 2nd, at three o'clock, under the presidency of the Bishop, to whom a vote of thanks was unanimously given for his attendance during the preceding sessions. The business of the Congress was brought to a close after a short discussion on the New Code and Class Subjects and Music.

SHAKSPEREAN EXAMINATIONS FOR PUBLIC ELEMENTARY SCHOOLS—1883.—The Committee of the Dramatic Reform Association have set on foot Annual Shaksperean Examinations, and offer prizes for competition, in order to encourage the study of the best dramatic literature in public elementary schools. The play selected for the examinations to be held in 1883 is 'Julius Cæsar.' Competitors will be required to have a general knowledge of the whole play, but a special knowledge of Act I., scene ii., line 79—177; and of Act III., scene ii., line 71—228. Text-books: The Clarendon Press, Collins', Chambers', or Hunter's edition of the play. The examinations will be *written* and *oral*. The purpose of the written examination will be to test the competitor's knowledge of the play—of historical or mythological allusions—of the sources whence the plot is derived—and of the meaning of peculiar phrases, words, etc. The oral examination will test the competitor's powers of elocution, either by recitation or reading. Although recitation is not compulsory, more weight will be given to it than to reading. These examinations will be held at the end of June, 1883. *Regulations.*—The following are the regulations for the examination in Manchester:—All public elementary schools in Manchester, Salford, and neighbourhood may take part in the competition—there is no entrance fee. Each school will be allowed to send up two per cent. of the number on its books; competitors should have passed the fifth standard. There will be a preliminary examination in reading or recitation in April, 1883. *Prizes.*—The first prize will be awarded to the competitor who obtains the highest total of marks in the written and oral examinations put together, the proportion of marks being two-thirds of the former, to one-third of the latter. The two next prizes will be of equal value, and will be awarded to the two competitors—neither being the winner of the first prize—who shall respectively obtain the highest number of marks for paper-work or for elocution. The remaining prizes will be awarded to those competitors who obtain places after the first and second in the written and in the oral examinations respectively—an equal number being assigned to each. The names of intending competitors should be sent in to the Honorary Secretary, D.R.A., Mr. J. STUART BOGG, Higher Downs, Bowdon, Manchester, prior to January 31st, 1883.

Publications Reviewed.

*** We are sorry to disappoint the many friends who desire us to quote the price of each work noticed in our columns. This we would respectfully point out is the publishers' duty and not ours; we give publicity enough to a book when we review it. Our readers should peruse the advertisements in our pages, and failing to find the price here, it would be no great trouble or expense to drop a line to the publishers, whose name and address we will gladly give.

Lamb's Tales from Shakespeare. Whittaker and Co.

This shilling handbook of an amusing and instructive batch of famous stories is worthy of a large sale, albeit the print is trying to the sight; but if the public will demand such cheap editions, they cannot expect them to be *de luxe*. It is well known that Charles Lamb was mainly helped in these tales by his poor mad sister, in her saner seasons, and that 'the gentle Elia' delighted in them for her sake, as making her forget the tragedy of her life.

Plutarch's Lives for Everyday Readers. Whittaker and Co.

Another little book produced in the same style, and chiefly remarkable for the omission of certain passages in the original, which could not fail to offend modern decency and morality.

A Handy Classical Dictionary. Whittaker and Co.

The same remarks apply to this small manual also. All the series appear to be well suited for the popular advantage.

Grammar School Classics. Whittaker and Co.

1. *Virgil's Georgics, I. and II., with English Notes and Arguments.* Abridged from Conington by the Rev. J. G. Sheppard, D.C.L., Head Master of the Grammar School, Kidderminster.

A very attractive little handbook, that cannot but recommend itself both to teachers and pupils.

2. *Virgil's Æneid: Books I. and II.* Similarly abridged by the same Editor.

A companion small volume, with the like recommendations. It is a great improvement on the classics of our boyhood to find the explanatory notes in easy English, instead of a dog Latin more difficult than the text; and the arguments and introductions are an additional advantage.

3. *The Anabasis of Xenophon: Book I.* With notes, introduction, an itinerary, and three maps. By the Rev. J. F. MacMichael, B.A., Head Master of the Grammar School, Ripon. Revised edition.

This beautifully-printed Greek classic, with English notes, preceded by a life of its celebrated author, and an elaborate introduction, is another of the useful school-books issued by Messrs. Whittaker, which help to make the ascent of the Mount of Knowledge a pleasure instead of a toil. We cannot sufficiently recommend such excellent manuals.

Anecdotal Illustrations of the Gospel according to St. Mark. Founded on a collection made by J. L. Nye. London: Wesleyan Methodist Sunday School Union.

This is a pleasing and most readable book which, while being explanatory of the sacred text, is brim full of anecdote bearing the impress of truth and soberness. Many religious anecdotes have the fault of being too highly coloured, and give exaggerated illustrations of human effort. We have no such complaints to urge against the little book before us. The illustration of a miracle given by a reverent Scot is similar to that adduced by Babbage in his Ninth Bridgewater Treatise—that the miracle is an alteration of the usual procedure, commonly called the laws of nature, and not a violation thereof. We have in this pleasingly written book some of the most popular of modern writers placed under contribution, among which we may mention Dean Stanley, Mr. Hughes, Colwell, 'The Land and the Book,' Dr. Geikie, 'The Dictionary of Illustrations,' Grossart, and others, besides the valuable and always suitable remarks of the author. The book is also well printed, and in neat cloth binding.

The Monograph: a Collection of Indexed Essays. By Q. P. Index. Bangor, Maine (United States), 1882.

The idea of collecting the most successful essays that have graced the pages of our leading quarterlies, has been carried out by us chiefly in connection with authorship. Those of Macaulay have doubtless attained the greatest popularity. For particular essays most readers endeavour to buy up the particular numbers of the leading periodicals when they are offered at some fifth or sixth of the original cost. We know of no plan to supersede such a method of selection. This monograph comprises essays on historical subjects, together with the biographies of leading characters, treated in essay fashion. The first annual volume, of which we have a selection forming a specimen number, opens with Mr. Freeman's 'France,' and contains also Goldwin Smith's 'Greatness of the Romans,' Seeley's 'Puritan England,' Shelton's 'Fouquet.' This latter, reprinted from 'The Atlantic Monthly,' excited considerable attention last autumn. Read side by side with the life of Mazarin, the wily nature of the selfish Louis XIV. will be traceable greatly to the incessant broils through which the astute Italian conducted, though with difficulty, the mother Queen, whom he eventually married. Those who seek for historical parallels may trace many points of resemblance between the French King and our Henry VIII. There was the same intense love of absolute power, the same energy, self-reliance, and the same mixture of envy, meanness, and greed, with the absence also of the noble hatred of the crooked and dishonourable that forms the saving feature of a gentleman, however harsh and overbearing. The most brilliant essay, however, in the part before us, is Goldwin Smith's 'Thirty Years' War,' and the weakest that on Calvin and Servetus, by W. L. Bacon, which latter is largely made up from an article on Servetus which appeared in a not very recent number of 'The Westminster Review.'

A Latin Grammar. By J. R. Leonard. Thomas Murby.

There are many useful hints and facts in this little book which make one wish it had been more thoroughly revised and more carefully printed. It commences with a short account of the Latin language, and a useful list of the chief Latin authors and their works. We agree with Mr. Leonard when, in reference to the pronunciation of some words and phrases borrowed from Latin and introduced into the language of common life, he says that certain rules have been 'so much disregarded by persons of good classical education, that it is very difficult to decide whether we should be guided by the well-established pronunciation or by classical accuracy. Following the latter, we should pronounce the first *a* in *Diana* long, and the *e* in *Venus* short, and should say *Nota benne, bonna fidde, minnus, et caetera*, etc.'

The usefulness of the book for school work is sadly marred by the numerous typographical and other errors which appear in it, and by the general want of clearness in both arrangement and expression. We do not, for instance, think that the author's meaning is very plain when, on page 14, the pronunciation of ph, th, is given as p+h, t+h, nor do we quite agree with him when, on the following page, he says that in such a phrase as '*thrice consul*,' the adverb *thrice* qualifies the noun *consul*. It seems to us rather to qualify some such word as '*appointed*' understood.

We may add, too, that when a *period* or *full-stop* is placed after a word it means that this word is the abbreviated form of some longer word. Such forms, therefore, as Cum., De., Ex., which occur in the list of prepositions on page 64, are misleading.

With all its faults, however, Mr. Leonard's book contains much that is useful and interesting.

The Oxford Examiner. No. 3. Edited by Mary W. J. Shilleto. London: Thomas Laurie, Paternoster Row.

This new magazine deserves to succeed. It affords the best help (in the form of examination questions) to students preparing for the Oxford Junior, Senior, and Women's Examinations.

A Descriptive Catalogue of Historical Novels and Tales. By H. Courthope Bowen, M.A. London: Edward Stanford.

We thank Mr. Bowen for this handy booklet, which should find its way into every school and library in the kingdom.

The Pocket Code and Teachers' Daily Handbook. By C. Bowden. Newcastle: Porteus and Co.

We are very much mistaken if teachers do not accord Mr. Bowden their best thanks for this really serviceable pocket-book. Its design is, to quote the preface: (*a*) To place in the hands of every teacher in the school the daily requirements of the Mundella Code; (*b*) To obviate the necessity of a constant appeal to the general time-table of the school by giving each teacher the opportu-

nity of carrying the whole or a part of it in his pocket; (*c*) To provide in connection therewith a note-book to record any instructions given or received either as regards lessons or classes throughout the year; (*d*) and generally to serve as a handy means of reference to the daily routine work of the school. This comprehensive and excellent design has been well carried out.

Caldicott's New Code. London: Blackie and Son.

Mr. Caldicott has rendered managers and teachers good service in issuing this carefully tabulated edition of the Mundella Code. Under the heads, 'Schools or Classes for Older Scholars,' 'Infant Schools or Classes,' 'Evening Classes,' and 'Drawing for Day Schools and Pupil Teachers,' he has given every kind of information an intelligent teacher could desire. An additional advantage of this edition is that it contains a list of books published by the Messrs. Blackie, specially suited to the requirements of the New Code.

Our Little Ones. London: Griffith and Farran.

The number of this magazine, just to hand, is beyond praise.

Short Essays and Letters. Manchester: J. B. Ledsham.

It is with sincere pleasure we introduce this modest looking packet of twenty-four cards (each different) to the notice of our readers. Every card contains either a 'model' essay or letter, couched in simple language and designed for copying, dictation, or analysis. Many of the subjects dealt with have actually been proposed by Her Majesty's Inspectors of schools. These cards meet a long-felt want, and their introduction into any school must be followed with most satisfactory results.

Universal Instructor. Part 19. London: Ward and Lock.

This useful serial keeps up the high character of its earlier numbers.

Roach's Practical Examiner's Arithmetical Tests. London: Thomas Murby.

Many teachers will welcome these cards because the sums are not too stiff. There is an ample variety of exercises on the twenty-four cards, each of which contains five different sums. Three answer cards accompany the packet.

The A B C Education Code. London: Nelson and Sons.

To many people, and especially to young correspondents and managers, the ever changing code is a kind of inexplicable 'Bradshaw.' It was therefore a happy idea to issue this simplified A B C Code of March 6th, 1882, which contains every article and every schedule arranged under alphabetical headings. The publishers may therefore well claim for it the advantages of ease, directness of reference, and completeness of view.

The A B C Code will prove invaluable to all interested in English elementary education.

Home Lesson Books to the Royal Geographical Readers, in five parts. London: Nelson and Sons.

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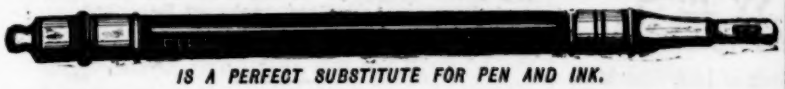

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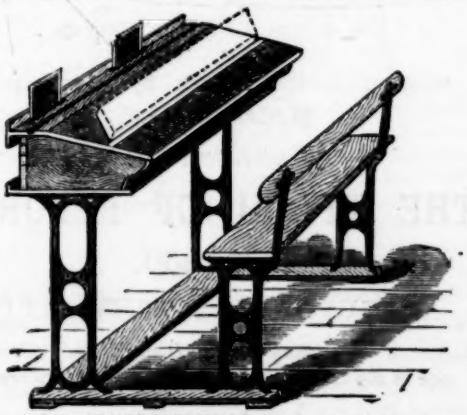

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